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A Computer-Assisted Teacher Training System.

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This series of working papers represents early stages in the development of a versatile and economical Computer-Assisted Teacher Training System (CATTS) for special educators, a system capable of providing immediate visual feedback of data relevant to teacher-pupil interaction in a classroom setting. Part 1 discusses the problem of existing systems of classroom analysis: delayed feedback and the tedium of coding, summarizing, and analyzing verbal interaction data. Part 2 discusses the philosophical rationale and cybernetic model guiding development of CATTS. The components of the system (teaching situation, observation-coding station, and analysis-encoding station) are outlined and the initial computer prototype program described. Part 3 presents an overview of the initial pilot demonstration study with CATTS. Charts illustrate the different facets of the system in operation and the cathode ray tube cumulative functions used as feedback information to the instructor of an educational psychology class. Part 4 is a description and preliminary evaluation of four visual display programs developed for CATTS. Part 5 reviews the literature relevant to major facets of CATTS: the problem of training special educators for the retarded, existing systems for the analysis of classroom behavior, and the role of feedback variables in teacher training. (Author/JS)

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Working Papers

PROJECT CATTS

The Development of a Computer-Assisted Teacher Training System

M. I. Semmel

Spec 247

CENTER FOR RESEARCH ON LANGUAGE AND LANGUAGE BEHAVIOR

Working Papers

A COMPUTER-ASSISTED TEACHER TRAINING SYSTEM[1]

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PROJECT CATTS I

A Computer-Assisted Teacher Training System[1]

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Early stages in the development of a computer-assisted teacher training system (CATTS) for special educators are reviewed in five sections. Part I discusses the problem of existing systems of classroom analysis -- i.e., delayed feedback and the tedium of coding, summarizing and analyzing verbal interaction data. Part II discusses the philosophical rationale and cybernetic model guiding the development of CATTS. The three components of the system are outlined and the initial computer prototype program is discussed. Part III offers a brief overview of the initial pilot demonstration study with CATTS. Photographs illustrate the different facets of the system in operation and the cathode ray tube (CRT) cumulative functions used as feedback information to the instructor in the pilot demonstration. Part IV presents a description and preliminary evaluation of four visual display programs developed for CATTS. Part V consists of a preliminary review of the literature on the problem of training special educators, on existing systems for the analysis of classroom behavior, and on the role of feedback variables in teacher training.

Although teacher training programs generally lack specificity about their behavioral objectives and procedures, there seems to be an agreed hierarchy of emphasis on what is deemed important in the training of teachers. Such variables as amount and nature of practicum experiences figure prominently -- probably because direct contact is thought more valuable to students than vicarious lectures and discussions about teaching. However, simply providing opportunity to observe in an appropriate practicum setting does not assure the growth of trainees' teaching skill any more than does lecture or discussion in a university methods course.

Programs differ considerably in the nature and amount of structure offered to university trainees in practicum environments. Several models are currently being utilized. At one extreme the trainee is simply assigned to a "master" teacher, who assumes responsibility for training the apprentice (e.g., Hielson, 1965; Olson & Hahn, 1964), usually to teach as he does, but often to perform special missions like working with specific children and performing minor non-teaching tasks. At the other extreme is found systematic university supervision of trainees *in situ*, followed by a supervisory conference during which the supervisor's impressions are transmitted to the trainee, who is expected to modify his behavior accordingly in a subsequent lesson (e.g., Anderson & Little, 1968).

The latter model appears to be clearly superior to the former as a means of achieving the goals of a university training program. However, closer analysis of the supervisory process reveals that (a) the trainee often has little information about the specific behaviors deemed important to the supervisor, (b) the supervisor often has no systematic technique for focusing on relevant teaching behaviors (he often relies on vague *ad hoc* impressions), and (c) there is frequently little relationship between one supervisory conference and another.

As a perusal of the literature will show, very little attention, if any, has been given to developing and demonstrating methods of teacher training capable of eliminating the defects just described. Clearly there is a need for observational systems which focus on the variables deemed most important to the teacher training program so as to produce teachers who act in accordance with the philosophical orientations of the programs that train them. The need exists quite independently of any question about the validity of such orientations. Training programs must fully specify what they posit as

the most relevant behavioral variables in teaching and then develop procedures to observe and modify these behaviors systematically in the practicum classroom setting. To do so obviously calls for the development of systematic classroom-observation and feedback systems in teacher education.

Drawbacks of Existing Systems of Teacher-Pupil Interaction.

Whereas the field of Special Education has produced relatively little research on systems of observation of classroom teacher-pupil interaction variables, several categorical systems have been developed and tested by educational psychologists interested primarily in regular classroom interactions. These systems may be envisaged in terms of two related characteristics: (a) the nature and type of content categorized, and (b) the method used to make observations, code behavior, summarize and analyze data, and feed information back to the trainee.

Investigators have attempted to classify verbal interaction of teachers and pupils into different content categories. For example, Flanders (1964) at the University of Michigan has developed a system based on categories of teacher and pupil talk; Bellack's (1966) extensive system focuses on the nature of teacher-pupil interacting strategies in the classroom, while Gallagher's (1965) focuses on cognitive behaviors modeled after Guilford's paradigm for the structure of the intellect. Still other categorical systems have been presented which isolate what is thought to be "relevant" teacher-pupil behavior (see Medley & Mitzel, 1963).

The heterogeneity of the content categorized by these systems may be more apparent than real. If the criteria used to assign behaviors to categories are closely examined and stripped of the technical jargon peculiar to each system, then they may overlap more than at first appears. In any case, the intensive analysis of existing categorical systems, should yield valuable

information on what is considered relevant teaching behavior by a large number of researchers from different fields of interest.

As regards the second feature of existing observation systems, a remarkable commonality is found in the methods they use to collect, analyze, and feed back information to teacher trainees. Apparently all the systems are descriptive, that is, they are designed and used to describe or summarize the classroom interaction well after it has taken place. In other words, these approaches are essentially retrospective and have no effect on the particular teacher-pupil interaction being observed at any given moment.

The procedures used in applying these systems in training situations are essentially the same. The standard paradigm is displayed in Figure 1. An observer sits in the classroom and records the on-going interactions in a prescribed code; or the verbal interaction in the classroom may be recorded on magnetic tape and later transcribed and coded to conform to the particular system favored.

In more advanced methods like the one developed by Flanders (1964), observations are coded at regular intervals and the entries are subsequently summarized by the observer either in a matrix reflecting the sum of double entry Markovian chains (e.g., the number of items of behavior category X that followed category Y) or in terms of simple proportions of the behavior categories represented in the total corpus of verbal material coded. In any event, once the coded data are summarized and analyzed, the observer and the teacher analyze the summarized information and establish goals for subsequent performance (see Figure 1).

Place Figure 1 About Here

It can readily be seen that the systems just described are subject to several limitations: the extensive encoding and decoding entails considerable

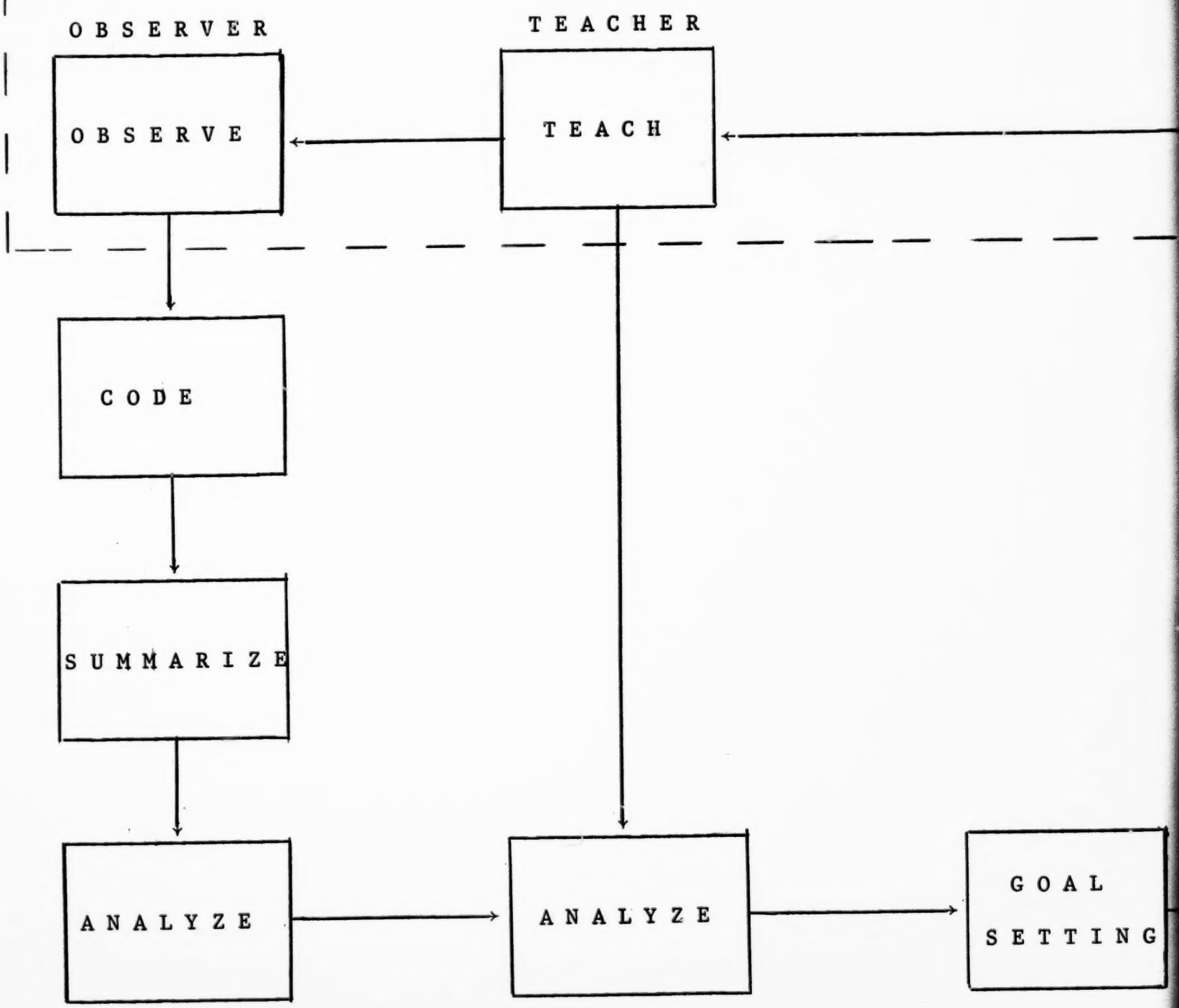

Figure 1. Traditional paradigm for teacher training techniques utilizing classroom interaction analysis techniques.

time and expense, and necessitates delay of feedback of relevant information to the trainee. To be sure, the new microteaching training technique utilizing closed circuit television (Allen, 1967) somewhat reduces these problems; but this technique does not appear to lend itself to immediate real-time feedback in the classroom nor to permit a systematic analysis, storage, and retrieval procedure during teacher-training sessions.

Project CATTS seeks to correct such limitations by introducing the following capabilities into the study of teacher-pupil interaction: (a) instantaneous feedback of relevant information to the teacher, while he is teaching, through a meaningful display located in the classroom; (b) the reduction of the tedium associated with coding, summarizing, and analyzing teacher-pupil interactions, and at the same time the provision for a permanent record of coded behavior; and (c) rapid storage and retrieval of pupil-teacher interaction variables for each trainee in the program.

Project CATTS' goal is, then, to develop a versatile and economical computer-based teacher training system with the capabilities for providing immediate visual feedback of data relevant to teacher-pupil interaction in a classroom setting.

When CATTS is operational it should be applicable to any training situation in which:

a. the interaction of teachers and pupils is to be summarized or analyzed in terms of any system composed of behavior catagories;

b. the summarized and analyzed data are to be fed back immediately to the teacher <u>in the classroom</u> through a meaningful display;

c. the behavior, once coded, summarized and analyzed by computer, is to be instantaneously stored for quick retrieval later.

Work on CATTS is presently directed toward practical application in university Special Education teacher training programs, in-service continuing education programs for special teachers in the schools, and all programs that train personnel to direct and lead groups of children or adults.

Earlier work on the analysis of pupil-teacher interaction in the classroom motivated the interest of the investigator and his associates at the Center for Research on Language and Language Behavior (CRLLB) in the problem of the systematic analysis and modification of teacher behavior. Two preliminary studies made use of the Flanders' technique of interaction analysis to determine what qualitative differences in verbal behavior exist among teachers who teach different types of children. Semmel, Herzog, Kreider, and Charves (1966) and Semmel, Herzog, and Jorgenson (1965) found interesting differences between teacher-pupil interaction in classes for educable mentally retarded (EMR) pupils as compared with classes for trainable mentally retarded (TMR) and normal pupils. Teaching patterns in classes for TMR pupils varied with teacher attitude scores on the Minnesota Teacher Attitude Inventory (Semmel, Herzog, Kreider & Charves, 1966).

Semmel and his graduate students subsequently undertook an extensive demonstration-research project designed to determine the effects of feedback on teacher trainees who were systematically observed and evaluated during 15 half-hour practicum teaching lessons. Trainees were taught to use the modified version of the Bellack system of analysis to evaluate their performance on magnetic tape recordings of the sequence of lessons which they taught; supervisors were trained to feed back corrective information to individual trainees and to suggest specific teaching styles according to the amount and quality of teacher talk in the classroom. This pilot work, which is still being evaluated, served as one of the precipitants for the development of CATTS.

It rapidly became evident that the only vehicle with the potential for satisfying the requirement of immediate feedback to trainees in the classroom while eliminating the tedium of coding, summarizing, and analyzing observational data was a computer-assisted system. Progress toward developing CATTS has been the work of a team of researchers from CRLLB, presently comprising the principal investigator (Dr. Semmel), four advanced graduate assistants specializing in the doctoral program in Mental Retardation with an emphasis on Teacher-Training at the University of Michigan, a computer programer and systems analyst (T. Rand),and an electronics specialist (J. Olson).

The team set itself three preliminary goals: (a) to review literature relevant to CATTS; (b) to develop specifications for the hard- and software for CATTS, and (c) to simulate a prototype CATTS with the help of existing CRLLB facilities and equipment. The present report traces the progress made toward achieving these preliminary objectives.

PROJECT CATTS II:

Description of Prototype CATTS

Melvyn I. Semmel

In their work, Cybernetic principles of learning and educational design, published in 1966, Karl and Margaret Smith espouse an approach to human learning based essentially on the findings of early researchers in human engineering. The Smiths argue convincingly for a cybernetic interpretation of behavior -- one quite different from conventional theories of learning. The cybernetic approach is a "general theory of behavior organization which ... views the individual as a feedback system which generates its own activities in order to detect and control specific stimulus characteristics of the environment." CATTS is conceptualized as a closed-loop cybernetic system characterized by immediate feedback of relevant teacher-pupil interaction data to the teacher so that modification of behavior can be realized through regulatory teaching moves in accordance with a pre-determined strategy so as to create the desired classroom environment. The major goal guiding the development of CATTS is to furnish the trainee with relevant information concerning the state of classroom verbal interaction so that regulatory behavior can be initiated toward establishing a desired classroom learning environment.

The Components of CATTS Prototype I.

Figures 2 and 3 present the schematic diagram of the closed-loop prototype CATTS developed by the CRLLB research team. The components of the system are depicted as three interdependent stations: I. Teaching Station; II. Observation-Coding Station; and III. Analysis Encoding Station.

I. Teaching Station. This component consists of a teacher or leader and a class of pupils (or other type of group) with the cathode ray tube (CRT) of an oscilloscope clearly visible to the teacher.

Place Figure 2 About Here

Place Figure 3 About Here

II. Observation-Coding Station. This component consists of an observer seated in front of a one-way-vision mirror located between stations I and II. The observer operates a coding device consisting at present of eight or ten buttons (e.g., four teacher behavior buttons and four pupil behavior buttons). The observer uses any one of several coding systems to press the appropriate buttons corresponding to categories of teacher-pupil behavior within the system of behavior analysis being used. These coded signals are relayed to the Analysis-Encoding Station.

III. Analysis-Encoding Station. This component consists at present of a PDP-4 digital computer and a hard-copy print-out source. Signals received from Station II are processed instantaneously by the computer in accordance with a predetermined program. Output consists of a visual display, on the CRT at Station I, of the behavior under observation -- cumulative percentage curves, for example -- and a permanent hard-copy computer print-out at Station III.

The translation of the closed-loop cybernetic principle is thus achieved by using an observer-coder as the interface between the teacher and the computer. Behavior observed in Station I is coded immediately and relayed to the computer, which carries out the prescribed analysis and feeds the results directly back to the teacher in visual form. It is hypothesized that the

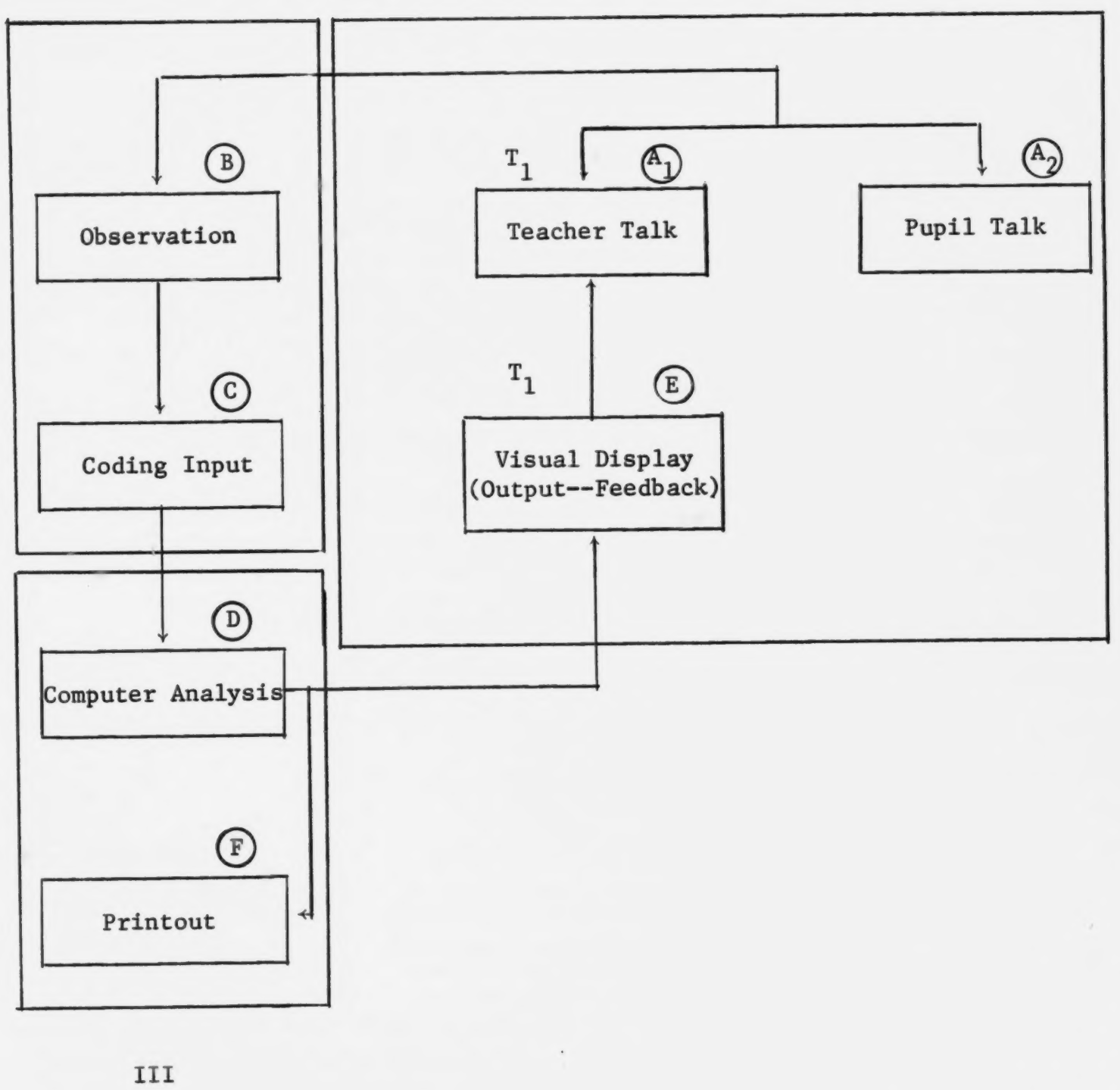

Figure 2. Schematic flow chart of CATT system.

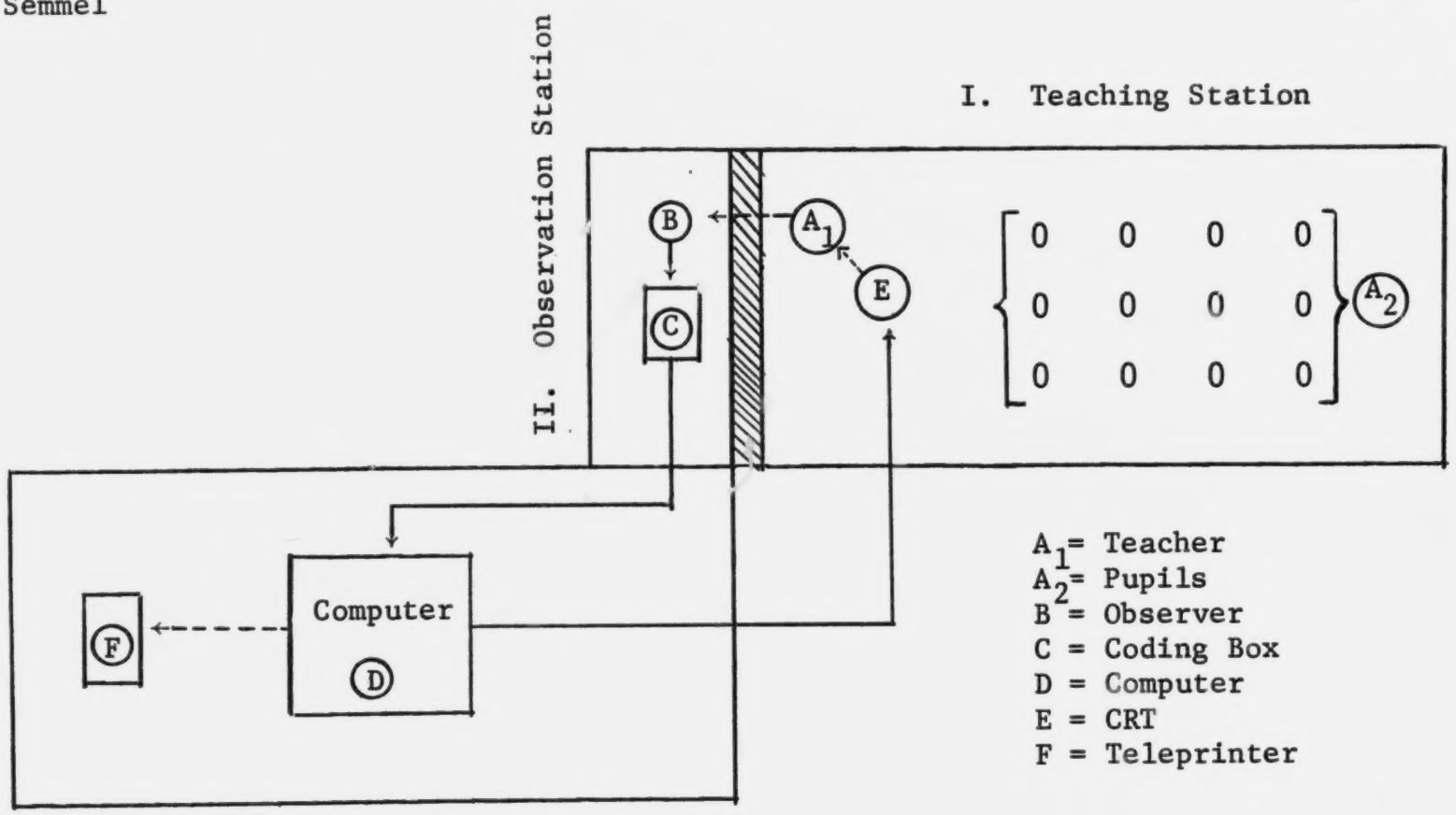

Figure 3. Schematic diagram of present physical arrangement of CATTS stations.

teacher can monitor his performance through CATTS and regulate his behavior to conform to specific behavioral objectives. It remains to be explored what use teachers can make of such feedback; we believe that significant modifications in teaching behaviors can be achieved through CATTS. A time-line feedback display for providing visual information to trainees was developed for the Prototype CATTS. The system and the feedback program were piloted in a demonstration study with an instructor of an introductory course in Educational Psychology who volunteered to conduct his class in the CRLLB laboratory.

Pilot Time-Line Feedback Program

The core of the apparatus is a small, general-purpose digital computer (Digital Equipment Corporation's PDP-4) with 16 multiplexed analog-to-digital inputs, 3 digital-to-analog outputs, and an 18-relay buffer. Eight push-button switches and a voltage source were connected to eight of the A-D inputs (see Figure 4) and one of the computer's relays was connected to a light in each of the push buttons. Two D-A outputs were connected to an x-y oscilloscope (Tektronix type 503) for horizontal and vertical control. Finally, an oscilloscope camera (Tektronix C-12) was available for taking pictures of the scope display. With this configuration of equipment the computer could sense buttons pressed by the observer, could signal the observer by turning on the lights, and could place a display on the oscilloscope.

The computer program, written in PDP-4 Assembly Language, consists of an executive routine that services three subroutines: (a) an A-D routine that looks for buttons being pressed and records them; (b) a display routine that plots the current output data onto the oscilloscope screen; and (c) a print-out routine that produces a hard copy of the output data on the computer's teleprinter. The executive routine also handles various timing and counting operations.

When the system is in operation and the program started, every button press increments one of eight counters (in the computer's memory), thereby keeping a running total of how many times each button has been pressed since the beginning of the current 15 min. period. Every 10 sec., two computations are performed: (a) the number of times that buttons 1 and 2 have been pressed is divided by the current total for buttons 1 through 4, and this quotient is multiplied by 100 to create a percentage; (b) the corresponding operation is performed to determine the percentage of presses of the first four buttons out of all eight.

These two percentage figures are added to storage vectors containing all such computed numbers since the start of he experiment. In addition, these numbers (and the time lapse since the start of the session) are printed on the computer's teleprinter every 10 sec. (printing a line takes roughly 4 sec.). The storage vectors containing the accumulated percentages are made available to the display routine, which continually plots as many values on the oscilloscope as the vectors may contain.

In addition to this ongoing process, the contents of all eight button counters are stored once a minute in another vector to be printed at the end of the session.

Whenever a 3-sec. interval of time elapses without button presses, the computer turns on the observer's button lights. These lights are extinguished when a button is pressed (See Figure 4).

Place Figure 4 About Here

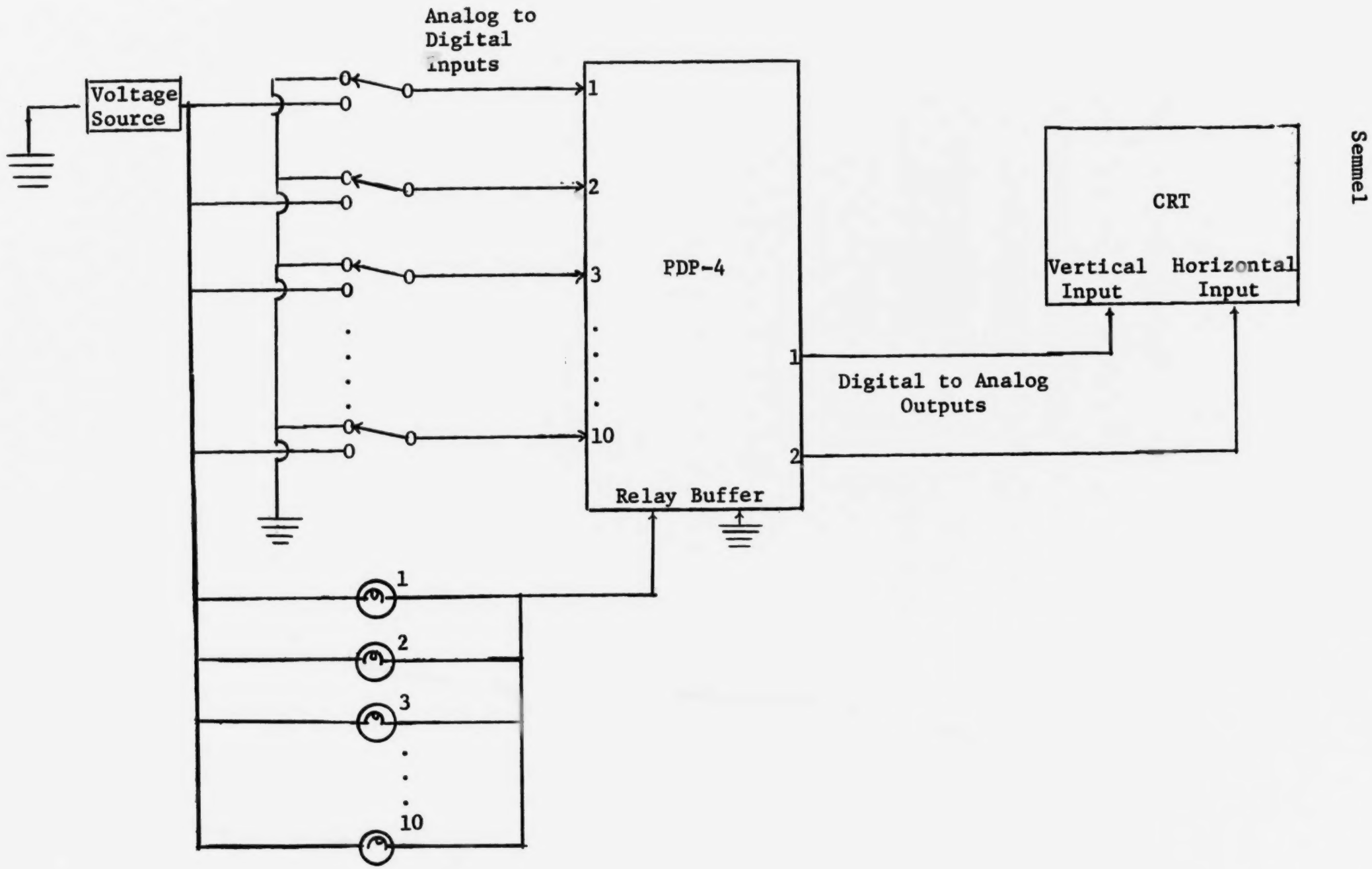

Figure 4. Pilot time-line feedback program--schematic diagram of hardware components for phototype CATTS.

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PROJECT CATTS III

Initial Pilot Demonstration Study Using CATTS

Melvyn I. Semmel, J. Kreider, J. Schmitt, H. Van Every, and P. Weaver

Procedure

An attempt was made to explore the feasibility of CATTS as a teacher-training device. The initial study was designed to uncover unanticipated problems with the system and to elicit subjective reactions of participants in the pilot demonstration. No attempt was made to evaluate the effects of the system on teacher behavior.

The instructor participating in the initial pilot demonstration study with CATTS was a graduate teaching fellow leading an educational psychology class for undergraduates at the University of Michigan. The class, composed of nine undergraduate students at the junior level, was led by the instructor in an informal group sensitivity training session.

Bellack's system of "Content Analysis" was used to record the verbal interaction which took place between the instructor and students in the class. Bellack defines four basic types of pedagogical moves to describe such interactions: (1) structuring, (2) soliciting, (3) responding, and (4) reacting.

Two of the pedagogical moves, structuring and soliciting, are described by Bellack as initiatory moves. Structuring moves are defined as "setting the context for subsequent behavior by (a) launching or halting excluding interactions between teacher and pupils, and (b) indicating the nature of the interaction in terms of the dimensions time, agent, activity, topic and cognitive process, regulations, reasons, and instructional aids" (Bellack, Kliebard, Hyman & Smith, 1966, pp. 16-17). Soliciting moves are

described as "intended to elicit (a) an active verbal response on the part of persons addressed; (b) a cognitive response, e.g., encouraging persons addressed to attend to something; or (c) a physical response" (Bellack, et al., 1966, p. 18).

Two of the pedagogical moves, responding and reacting, are presented by Bellack as reflexive moves. "Responding moves bear a reciprocal relationship to soliciting moves and occur only in relation to them. Their pedagogical function is to fulfill the expectation of soliciting moves and is, therefore, reflexive in nature" (Bellack, et al., 1966, p. 18). Reacting moves are "occasioned by structuring, soliciting, responding, or a prior reacting move, but are not directly elicited by them. Pedagogically, these moves serve to modify (by clarifying, synthesizing, or expanding) and/or to rate (positively or negatively) what was said in the move(s) that occasioned them" (Bellack et al., 1966, pp. 18-19).

CATTS Program III

A panel of eight buttons coded to accommodate Bellack's system was used with prototype CATTS. The four buttons on the upper half of the coding panel represented teacher moves in the class. One button was assigned to each of Bellack's four pedagogical move categories. The buttons on the lower half of the coding panel were used for student moves in the class with each button assigned to one of the four pupil move categories.

The coded information from the panel button presses was fed to a PDP-4 computer programed to operate a CRT display in the classroom. Two functions appeared on the feedback display: the upper function plotted the percentage of teacher moves within the total moves made in the class; the lower function plotted the percentage of reflexive teacher moves within the total teacher moves. Both the upper and the lower functions were divided into two 15-min. segments and summed the cumulative percentage over time for each of the two 15-min.

periods. Thus, the CRT display presented feedback information to the instructor across a 30-min. period in two 15-min. segments.

The demonstration consisted of three time periods--two 15-min. segments per period. Base line behavior was obtained during Period I (first 30 mins.) on the percentage of teacher moves within the total number of moves in the classroom, and on the percentage of reflexive moves within the total teacher moves. The teacher received no information from the scope during Period I.

Following the first period, the teacher and experimenters met to discuss the previous session. The Bellack system was explained to the teacher, who was also informed of his performance on the two variables tracked. The cumulative functions derived from Period I was reviewed (See Figure 11, Photo A).

The teacher was directed to decrease his reflexive moves. He was informed that the cumulative function of such moves could be observed on the lower portion of the CRT. He then re-entered the classroom and proceeded to teach (Period II) with the scope visible in the classroom.

At the termination of Period II, the teacher again reviewed photographs of his performance during the two periods. He was asked to maintain the level of reflexive moves during Period III.

Segment 2 of the third period was discontinued after 3 min. because several members of the class had to leave. Hence, Period III yielded data for 18 min. as compared to 30 min. each for the first and second periods.

Figures 5 through 11 present photographs of the different facets of the initial demonstration with the prototype CATTS. Figure 11 presents the cumulative time-line functions for the three periods of the demonstration.

Place Figures 5 Through 11 About Here

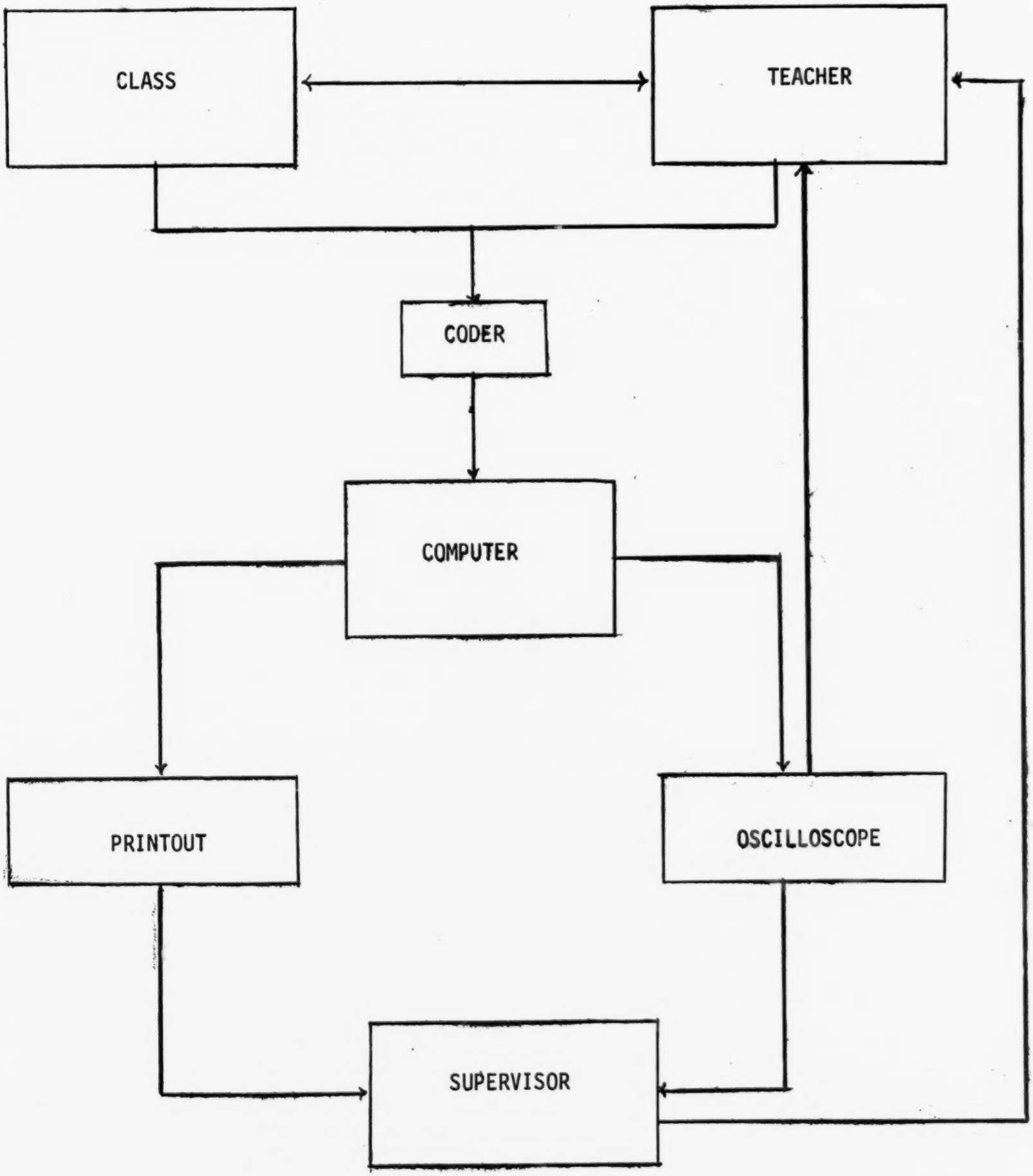

Figure 5. A flow diagram of the model utilized for the pilot demonstration of CATTS.

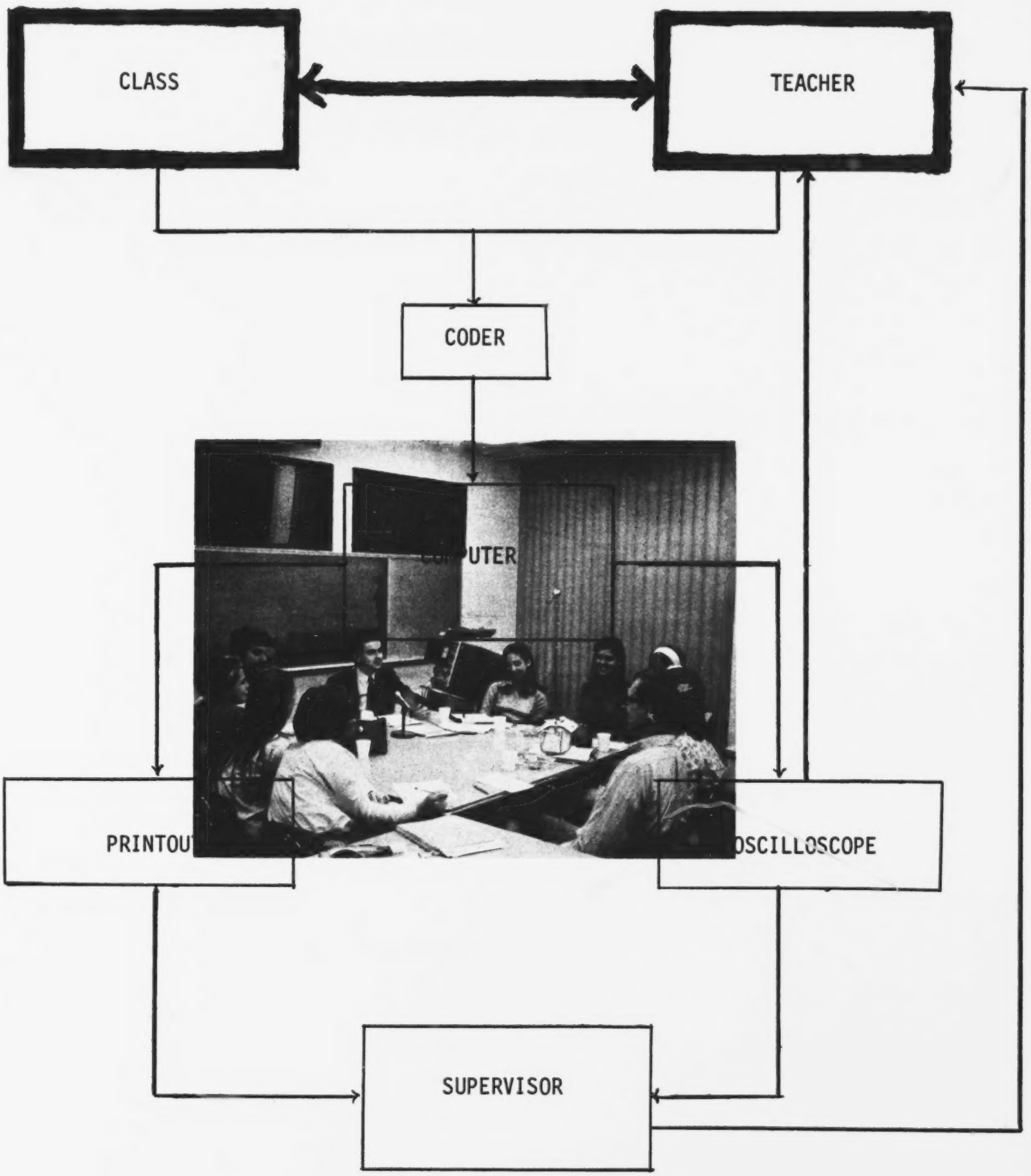

Figure 6. Station I of the CATTS system (Teaching Station) showing the instructor and students with the CRT feedback display. No visual feedback was given during Period I of the demonstration study.

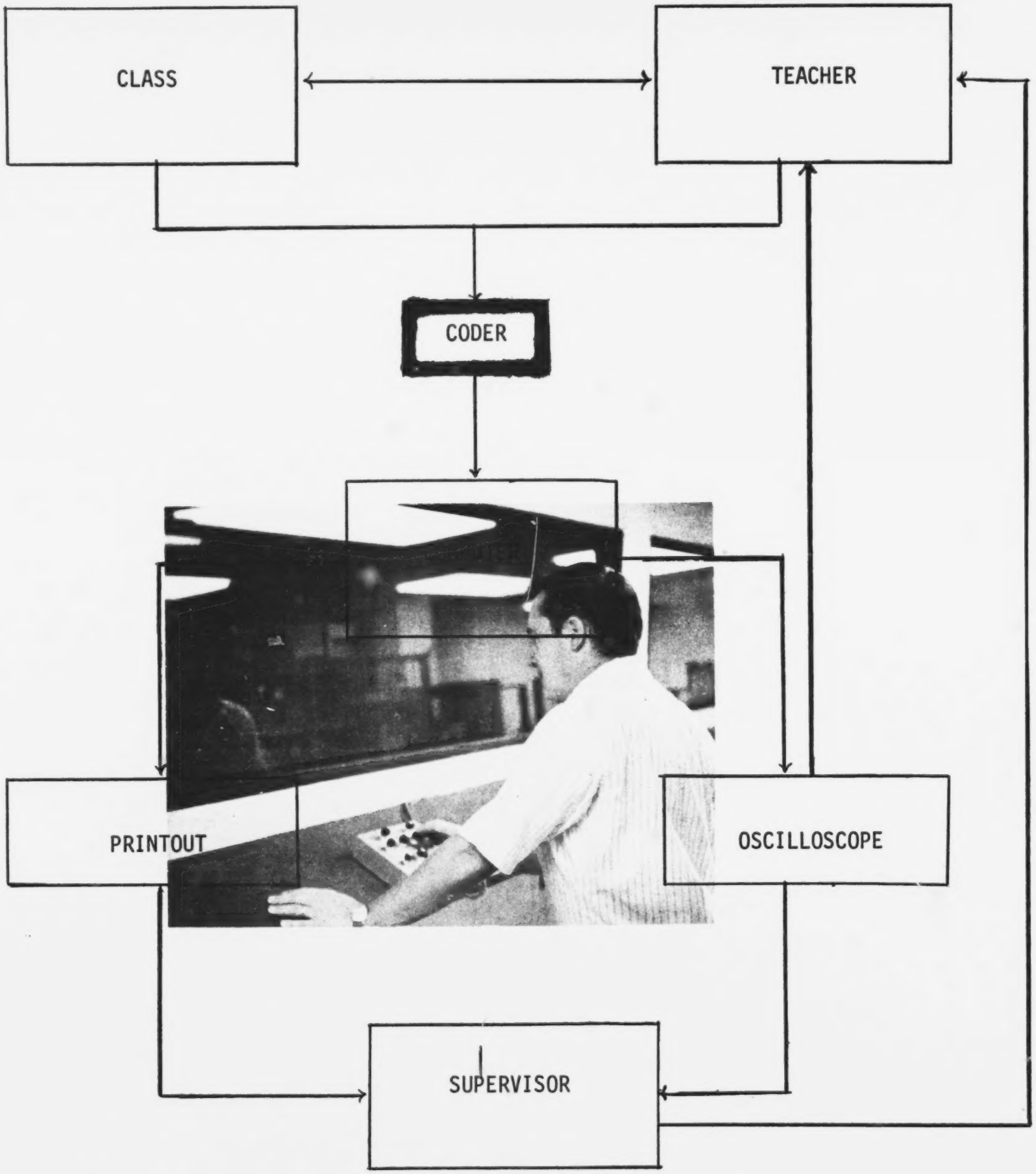

Figure 7. Station II (Observer-Encoding Station) showing the observer-coder and the one-way vision mirror.

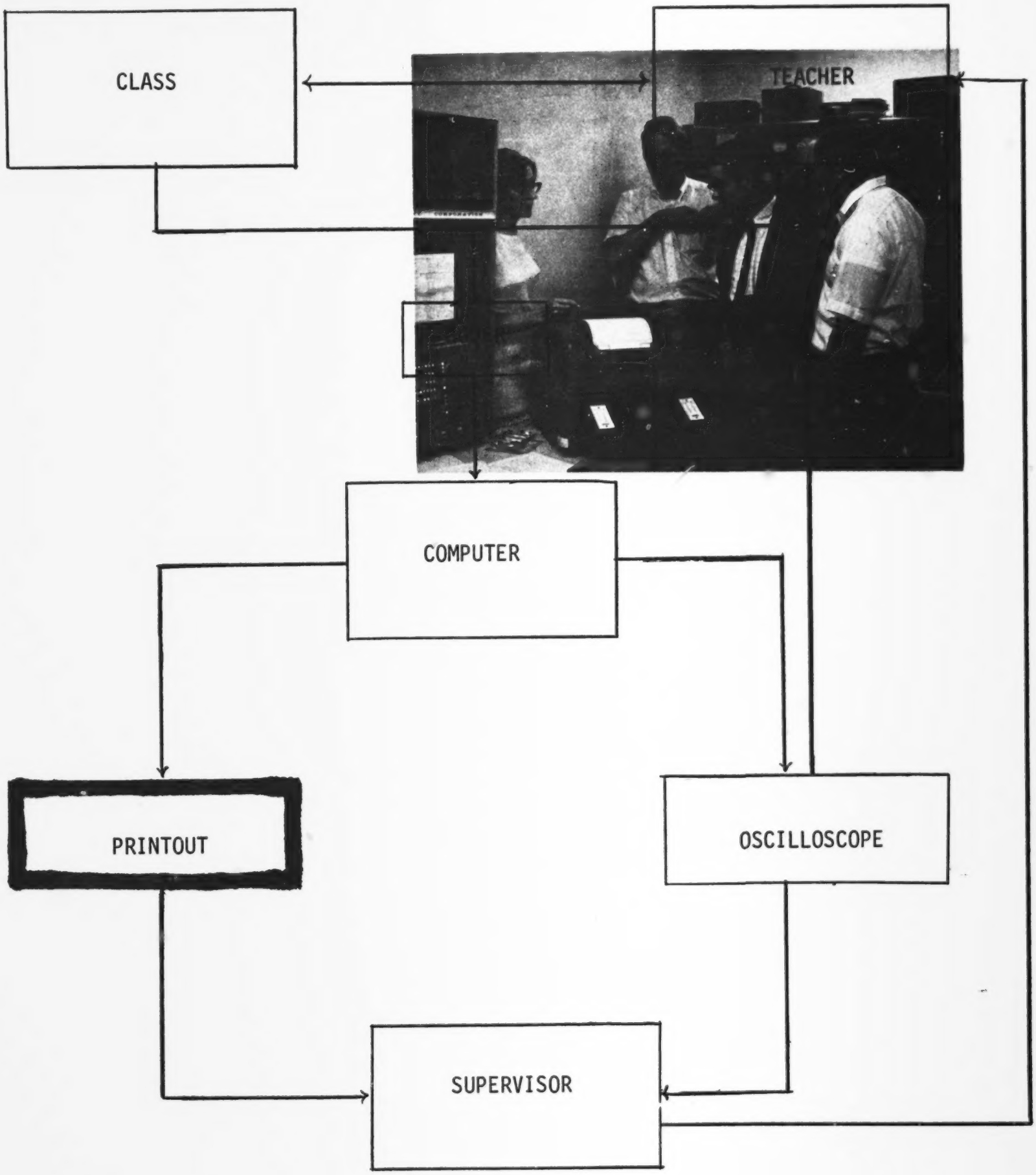

Figure 8. Station II (Analysis-Encoding Station) showing the PDP-4 computer and the high speed teleprinter.

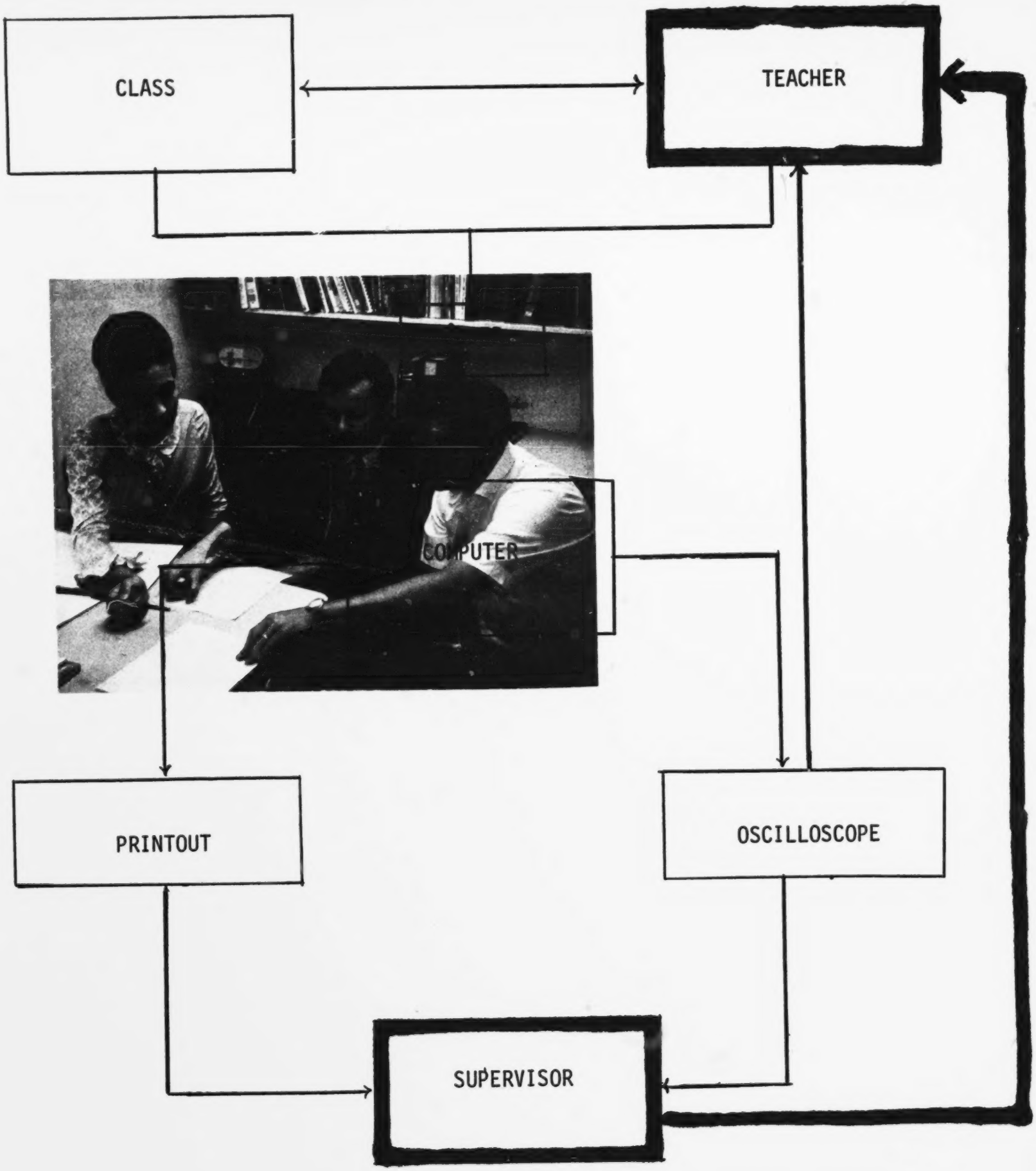

Figure 9. Experimenter and instructor reviewing baseline performance (Period I) and establishing behavioral goals for Period II.

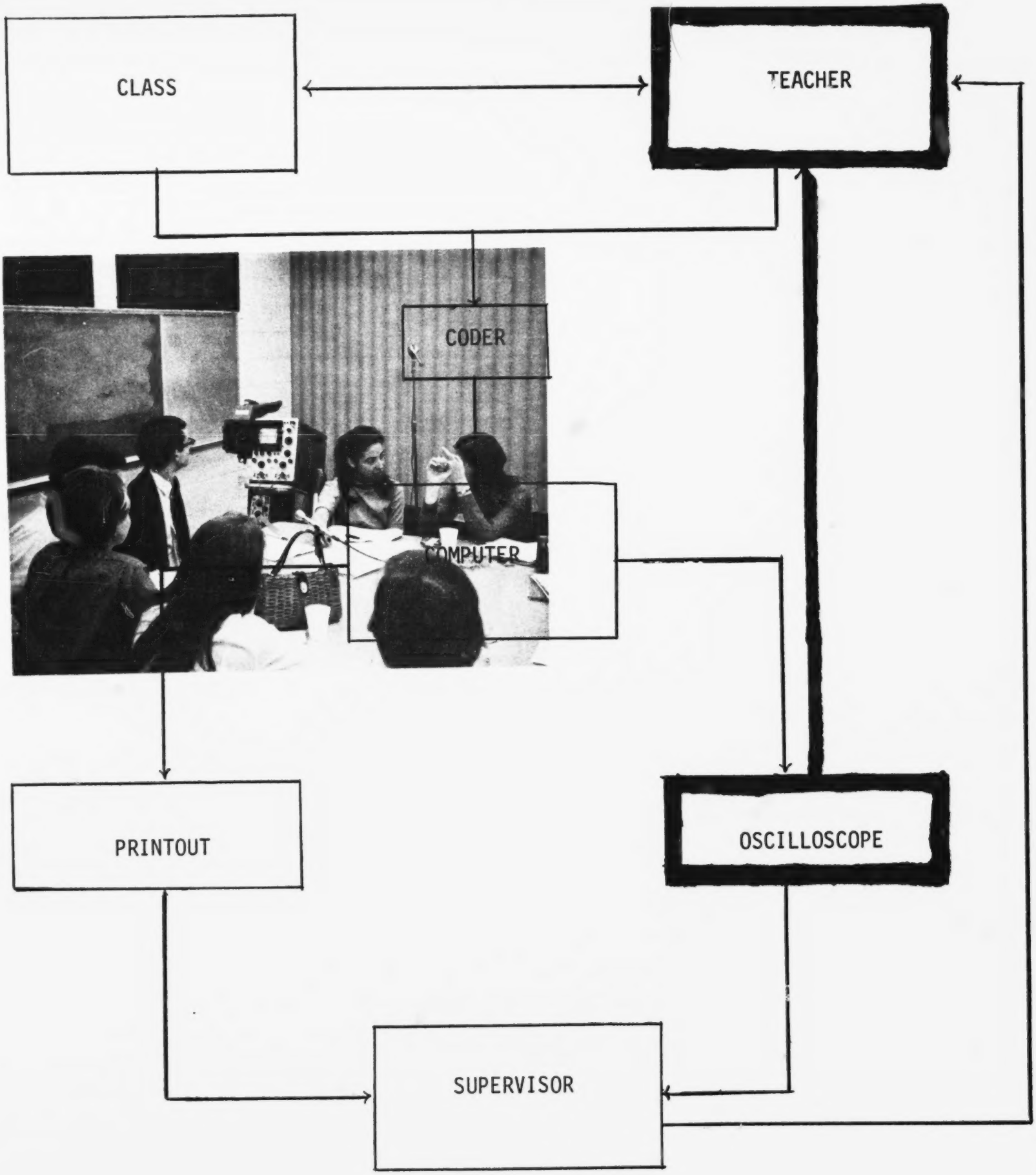

Figure 10. Teacher observing CRT for visual feedback during Periods II and III of the demonstration.

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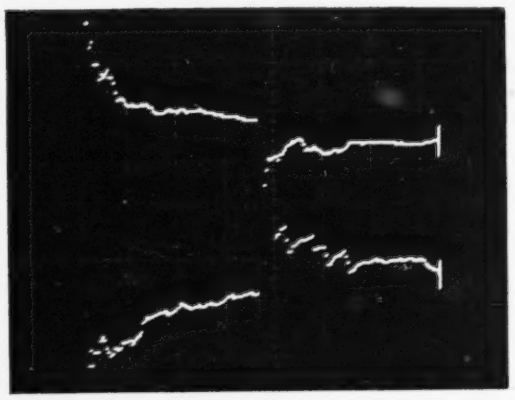


Photo A (Period I)
Shows baseline performance of percentage of teacher moves (upper function) and percentage of teacher moves categorized as reflexive (bottom function).

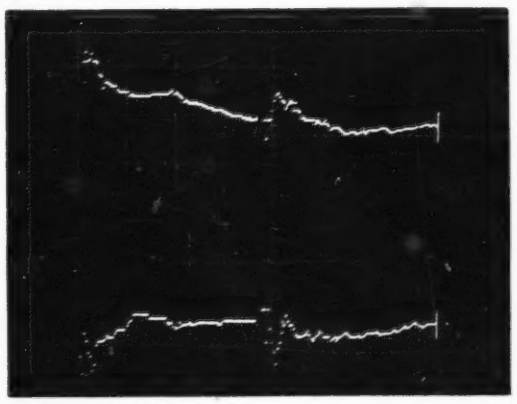


Photo B (Period II)
Shows the two functions for Period II (second 30 min. teaching period). Note the reduction of reflexive moves from Period I in Photo A to Period II in Photo B.

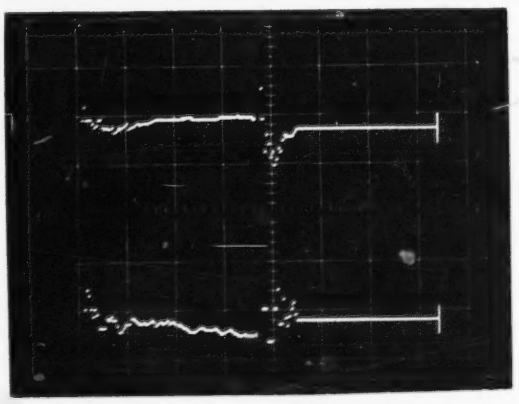


Photo C (Period III)
Shows the cumulative functions for the final period during which time the instructor was asked to maintain the level of reflexive moves achieved during Period II. Note that no data are recorded for the last 12 min. of the final segment because the class was dismissed at the end of 18 min. of Period III.

Figure 11. Polaroid photographs of time-line functions for the three periods covered by the demonstration.

Computer Printout

The computer was programmed to print out data sheets containing both percentage and frequency information for consecutive 10-sec. intervals. Here follows a sample of the percentage data in the printout for one minute.

1M*	10s*	80	25
1M	20s	80	18
1M	30s	79	21
1M	40s	73	31
1M	50s	72	33
2M	00s	66	33

*M indicates min., s indicates sec.

During the time interval from 1 min. to 1 min. 10 sec., the percentage of teacher talk to total talk was 80%; the percentage of teacher reflexive moves to total teacher moves was 25%. At 2 min. 0 sec. the cumulative percentage of teacher talk to total talk was 66% and the cumulative percentage of teacher reflexive moves to total teacher moves was 33%. The percentages are calculated every 10 sec. for the total amount of information fed into the computer since the start of the period. At the end of every minute the cumulative percentages are offset on the printout to enable quick observation.

The following is a sample of the frequency data from the computer printout for one 15-min. interval:

Button #	15M	Tot
1	14	(Teacher responding move)
2	47	(Teacher reacting move)
3	32	(Teacher structuring move)
4	14	(Teacher soliciting move)
5	31	(Pupil responding move)
6	28	(Pupil reacting move)
7	43	(Pupil structuring move)
8	13	(Pupil soliciting move)
	222	Total moves during 15-min. interval

Discussion

The initial use of CATTS in a classroom situation suggested directions for future development and study. It was determined that a teacher could

use continuous feedback within a classroom setting with minimal interference to his verbal teaching behavior. With very little introduction to CATTS, the teacher could apparently decode the information presented on the CRT and decode the types of behavior represented by this form of abstraction.

Our observations suggest that the cumulative curve was not sufficiently responsive in reflecting rapid modifications of the interactions in the classroom. The growing number of entries in the cumulative function render the curve less and less responsive to alteration by a single entry. In consequence, the visual feedback used in the demonstration proved sensitive to changes in the classroom only at the beginning of a session. If visual feedback is to be utilized in the CATTS system, then other types of displays and their effects on teacher behavior must be developed and assessed.

It was noted that the number of observing responses by the instructor was relatively low. However, he did claim to have used the scope for information about his success in modifying his behavior. Since an observer cannot be sure whether a teacher is observing the scope or merely gazing in its direction, a teacher call-up system may be necessary. The teacher might be required to press a button to illuminate the CRT display. The computer could record the time and number of the button presses and so provide an accurate record of the teacher's requests for feedback. In this way the relation between the teacher's requests and actual changes in behavior might be determined.

The instructor participating in the pilot study expressed considerable interest in the abstract representation of his classroom behavior that CATTS provided. An interview with him revealed that he felt comfortable in the situation and had many questions about other aspects of his teaching behavior which he was interested in tracking and modifying.

A system such as CATTS, which allows a teacher to focus on his classroom behavior, may well have promise in modifying these complex pedagogical moves. It must be emphasized, however, that in this initial demonstration no attempt was made to determine systematically or objectively the effects of CATTS on teacher behavior. The initial work reported here was directed toward determining the feasibility of utilizing CATTS in teacher training--to uncover unexpected problems and to derive suggestions for further developmental work. Pending such further work (e.g., development of hard- and softwear) rigorous experimentation directed toward establishing the general efficiency of the system must be deferred. Improvements in the system are evolving from experience with it, and will be reported in subsequent publications.

PROJECT CATTS IV:

Scope Displays Developed for CATTS

Melvyn I. Semmel, Tim Rand, and Jerry Olson

There are currently four displays being tested for use with CATTS. Each presents information on two variables of classroom interaction. The scope is divided into two graphs. The upper graph is reserved primarily for quantitative information, i.e., the amount of teacher talk as against total classroom occurrences. The lower graph is reserved for a more qualitative display, i.e., the amount of teacher praise and use of student ideas as against total teacher talk.

The ordinates of the graphs represent percentage points from 0 to 100, the abscissae represent time. Since the length of the program is optional up to a limit of 50 min., the displays may represent lessons of varying length. In an effort to compare displays, a single interaction session has been used to illustrate the various display programs.

Display 1: The Cumulative Percentage Function (CPF). In this display a curve is formed on the scope by entering a mean percentage point of all tallies up to that point every 10 sec.

An advantage of this display is that it gives a record of the teacher's total performance at any point in time for a particular interaction session.

A major drawback is that with a growing number of entries, the function becomes less responsive to any one particular entry. As a result, it is increasingly difficult for the teacher to effect a change in the plotted function toward the end of a session. For example, in the session used for

illustration, the cumulative mean percentage of teacher talk (top function) increased only eight percentage points during the last 7 min. of the class, although the teacher was observed to have talked constantly during this time period.

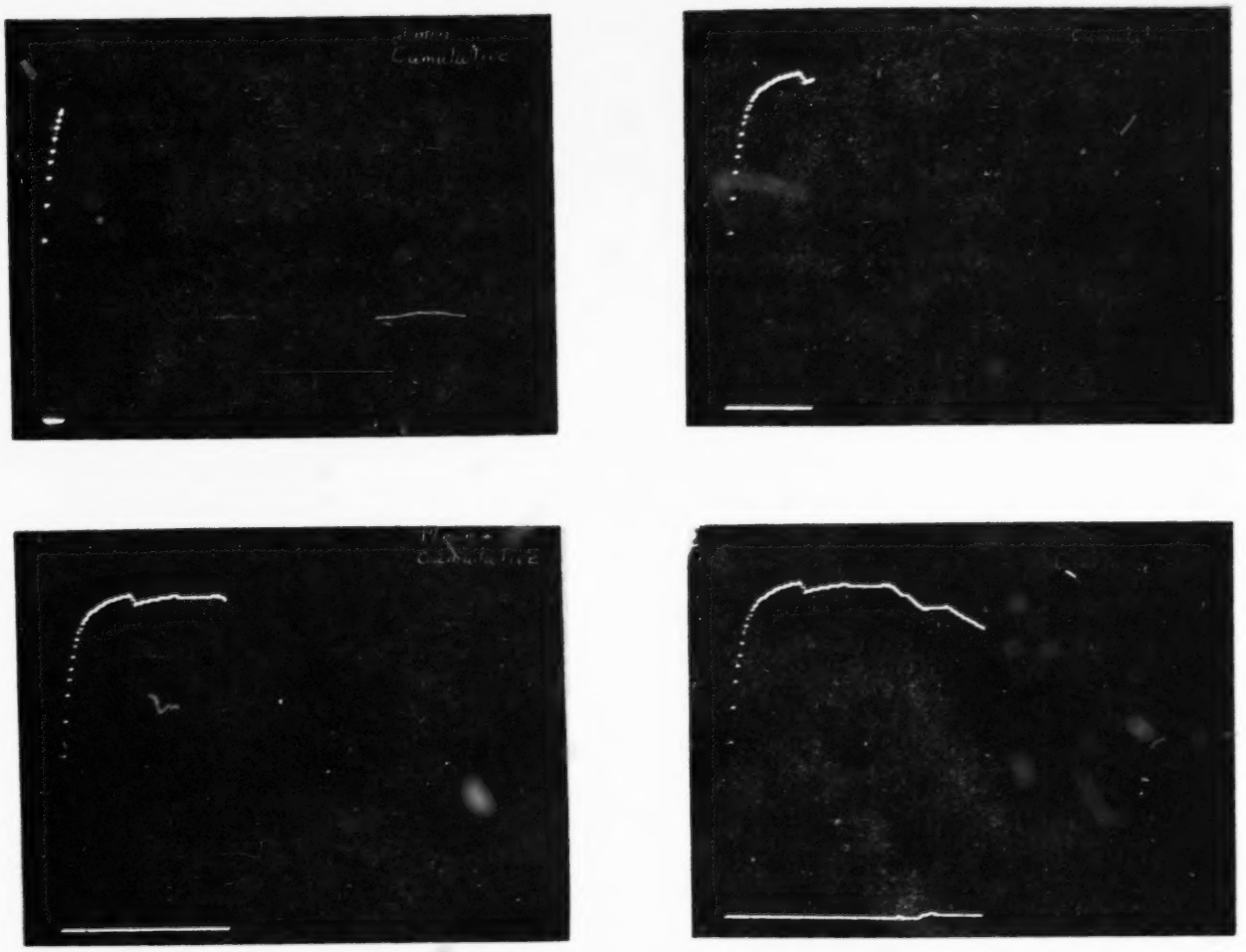
Place Display 1 Here

Display 2: The Moving Window Percentage Function (MWPF). This display was designed to make the CPF more responsive to short-term immediate changes during a session. For this curve, an entry is made on the scope approximately every 10 sec. However, the entry represents the mean of the previous 60 tallies for that particular graph. (Period and number of tallies are choice points in the program: The experimenter may specify N tallies or X amount of time.)

For all of the displays presented here the coding system employed was Interaction Analysis, which requires a tally every 3 sec. Therefore, the choice of 60 tallies for Display 2 entailed a 3-min. time period. If another coding system were used, the relation between time and number of tallies would change.

Since the same lesson was entered for all of the display illustrations, a comparison of the displays on the same information is possible. The more dramatic responsiveness of the MWPF to a decrease in teacher talk (toward the middle of the lesson in the illustration) might have a different effect on the teacher receiving feedback than the more conservative changes of the CPF. The drop in teacher talk seemed to be associated with a rise in the teacher use of praise and student ideas in the illustration session, a result that is not so readily observable in the CPF display of the same data.

Semmel



Display 1: The cumulative percentage function (CPF)

Displays 1 - 4. Program length (optional to 50 min.): 45 min.

Top Graph: Percentage of teacher talk to total classroom occurrences.

Bottom Graph: Percentage of teacher use of praise and student ideas to total teacher talk.

Oscilloscope enters mean percentage every 10 sec.

Place Display 2 Here

Displays 3 and 4: Approximation to a Goal. In these displays every 20 tallies are summed by the computer and a mean of those tallies is entered on the scope. Also on the scope is a line representing a goal for the level of the variable being recorded.

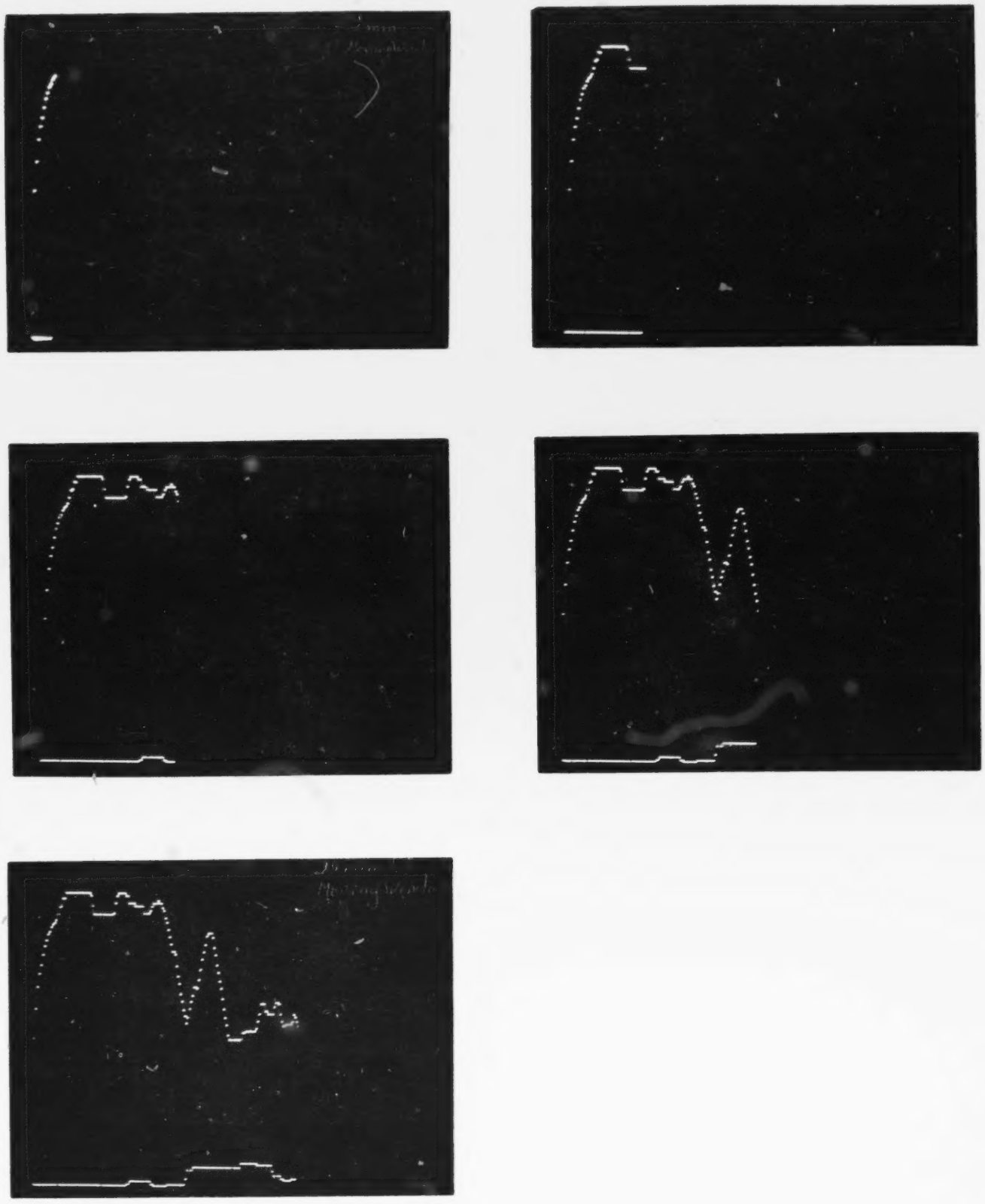
Display 3: Stationary Goal (AG-S). For illustration of this display, the top graph has a "goal" line plotted at the 60% level. This level is optional in the program; it was selected here only for demonstration purposes.

The AG-S display differs from the others in its responsiveness to time. It continues to make entries every 10 sec. at the level of the previous entry until an additional 20 tallies are accumulated. In other words, the length of the line on the scope represents the amount of time it took to accumulate the succeeding 20 tallies. When the 20 tallies accumulate, the mean of those tallies is computed and entered at a new level on the scope. A numerical representation of the level of the preceding 20 tallies is also presented.

Place Displays 3 & 4 Here

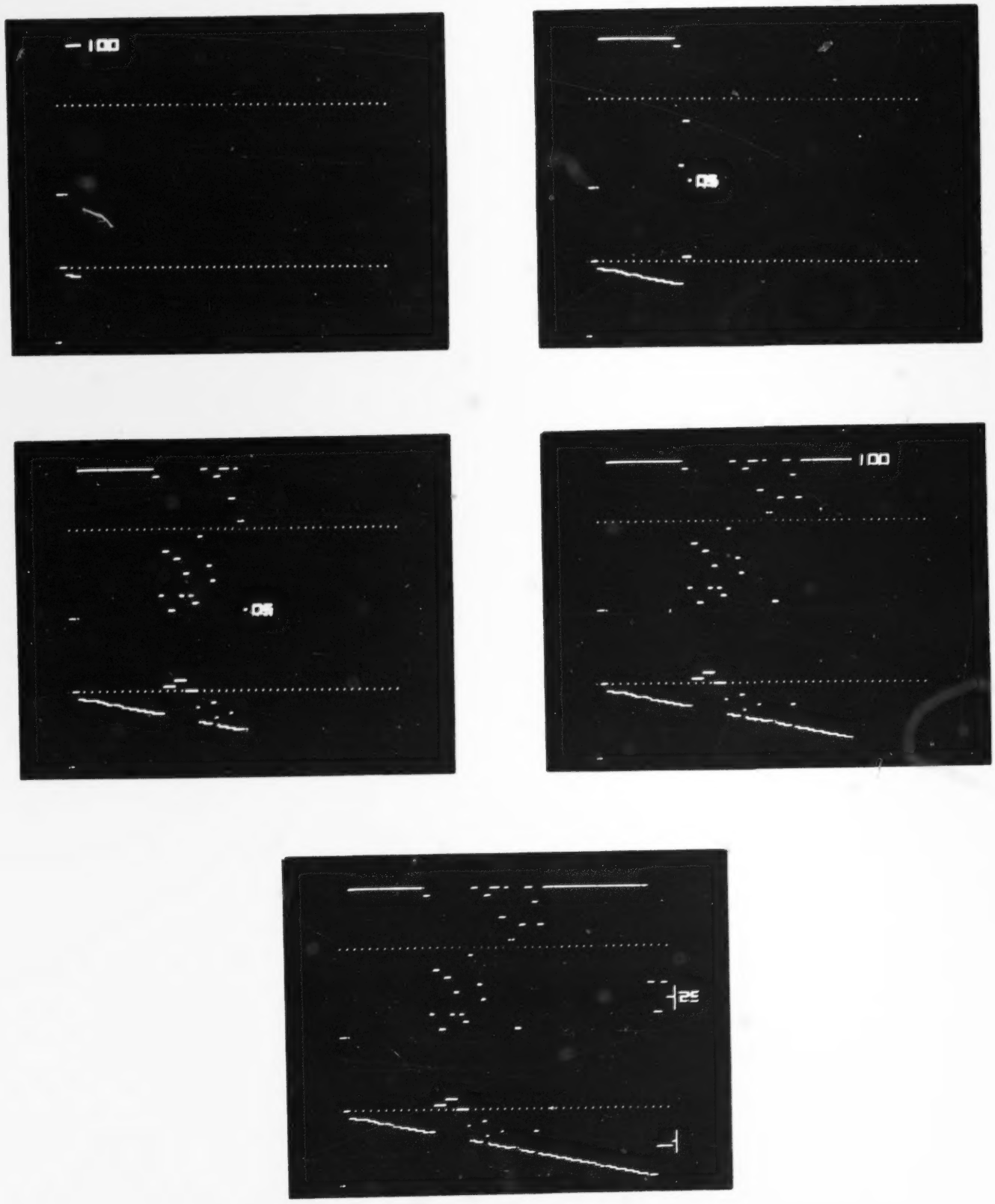
Display 4: Graduating Goal (AG-G). The bottom graph also displays a "goal" line. However, this line represents an increasing percentage level although it is a horizontal function on the CRT. In other words, the ordinate of the graph varies in its percentage values depending on the point in time of the entry on the scope.

In the illustration the "goal" line increases from 10% at the beginning of the lesson to 100% at its end. The values set for this line are optional. The teacher's performance on the use of praise and student ideas remained fairly constant, with some increase toward the middle of the lesson. The



Display 2: The moving window percentage function (MWPF)

Semmel



Display 3: Stationary Goal (AG-S). Top Graph: Goal line equals 60% (optional). 20 tallies are accumulated and their mean entered every 10 sec. until 20 new tallies accumulate.

Display 4: Graduating Goal (AG-G). Bottom Graph: Goal line begins at 10% and increases over time to 100% (optional). 20 tallies are accumulated and their mean entered in relation to the graduating goal every 10 sec. until 20 new tallies accumulate.

gradual rise of the preset criterion is reflected in the decreasing function of the teacher's performance in relation to the goal line.

Displays 3 and 4 appear to be most useful for shaping behavior toward a predetermined goal. Some degree of sophistication on the part of the trainee may be necessary for their effective use. A perceptual disadvantage arises when numerous changes in the level of behavior result in a "scattergram" on the scope. The ensuing difficulty for interpreting the image at a glance may limit the usefulness of Displays 3 and 4.

A version of the moving window might be practical in combination with Display 4. Instead of an entry every 10 sec. to represent the last 20 tallies accumulated, an entry could be made every 10 sec. to represent the last 20 tallies available. The result would provide a picture of fluctuations around the goal line and eliminate the dramatic changes in percentage level which are characteristic of Display 4 in its present form.

PROJECT CATTS V:

Review of Literature Related to The Development of CATTS

M. I. Semmel, J. Schmitt, and H. Van Every

This preliminary review is divided into three sections corresponding to the major facets of Project CATTS: (a) the problem of training special educators (with emphasis on mental retardation), (b) the analysis of existing analytical systems of classroom teacher-pupil interaction, and (c) the role of feedback variables in teacher training.

A. The Problem of Training Special Educators

Critics of teacher education contend that too much emphasis is being placed on dispensing information and unrelated theory (Bruner, 1963; Heather, 1964). While research in the preparation of teachers has increased (Gage, 1963), more attention must be directed toward the teacher's activities in the classroom (Anderson & Junka, 1963; Warburton, 1962). Teacher education should be organized around operational definitions of training objectives and the teacher-learning process (Heathers, 1964).

The level of scientific rigor of research in any field is often related to the level of previous research in that field. Research on teacher preparation in special education prior to the mid-1950's was indeed wanting (Cruickshank, 1965). Between 1959 and 1965 the work reported seemed to be primarily at the stage of early development. Special education lagged behind the general field of education in the output of empirical research, or teacher education (Cain, 1964). Blatt's (1966) survey of the literature yielded no experimental studies and few investigations of any kind that could be classified as systematic research

The few descriptive studies completed were of the opinionnaire-questionnaire sort.

The Preparation of Teachers of the Retarded

Some problems encountered by teachers of the retarded were demonstrated in a study of the teaching of reading by Mullen and Itkin (1961). They indicated that teachers of the retarded need a more adequate preparation than they are getting. Moreover, teachers themselves have felt their lack of training (Cain & Levine, 1961; Mackie, Dunn, & Cain, 1960). Sparks and Blackman (1965) suggested as a topic of investigation the hypothesis that special preparation results in a special approach to teaching the retarded child. Teachers of the retarded tended to restrict their interests in teaching methods to those applicable for the retarded (Mackie, Dunn, & Cain, 1960). Teachers need inter-disciplinary training with emphasis on broad concepts rather than on specializations (Cain 1964), Heber (1963), citing recommendations of a national conference on standards for the preparation of teachers of the retarded, emphasized the need for more training in the biological and behavioral sciences. Both Cain and Heber suggested that teacher candidates need direct contact with children while training.

According to Fliegler (1966), the preparation of personnel in mental retardation is in a heightened state of flux: innumerable pressures from diverse areas of our society are demanding more qualified teachers; yet not only are we faced with a shortage of teacher-candidates of suitable quality but we also have limited knowledge of how best to educate a teacher.

Blatt (1964), who discussed the inadequacy of present teacher-preparation systems, maintained that teacher-preparation programs had to include sustained intellectual discipline, with substantial work in the behavioral and social

sciences, all this associated with a process of continuous self-evaluation. Blatt took issue with the notion that highly complex classroom interactions could be usefully measured, and suggested an alternative strategy--measuring the simplest interaction. Ideally, the more control exercised over the environment, the more accurate the measurement would be. The measurement of teachers' interactions with children should be more concerned with their "doing" behavior than with their "internal" behavior. Since it is difficult to measure what a teacher is feeling or thinking, we must concern ourselves with his performance. In the last analysis, the overt behavior of teachers with children constitutes the only meaningful interactions we have to record.

For Gallagher (1967) the key to teacher preparation is in the demonstration to the teacher of how to interact meaningfully with the learner. This preparation must be mastered through observation, practice, and the provision of sufficient feedback about his performance to allow the teacher to analyze his behavior and to modify it systematically.

Olson and Hahn (1964) described and analyzed a special approach to preparing teachers of the mentally retarded. They recommended that undergraduate candidates have the following experiences: (a) a sound general education, with emphasis on the behavioral sciences, (b) early exposure to the field of special education, (c) instruction in curriculum and teaching methods, and (d) the opportunity to observe excellence in teaching. They assigned particular emphasis to observation and practice teaching. Directed observation of excellent teachers in action should be followed by a seminar in which the professor and the student jointly evaluate what was observed. These demonstrations might take place in public school classrooms, in university demonstration classes, and under certain conditions, in university classrooms where the curriculum methods course was taught. During the last phase of teacher

preparation students should be assigned to full-time student teaching with provision for weekly seminars concentrating on problems encountered during the teaching day.

According to Fuchigami (1967), a critical problem in teacher education programs is the employment of adequately trained critic teachers. His solution: a university course to train critic teachers for supervisory roles in the area of mental retardation.

Shane and Shane (1967) proposed an extensive in-service training program involving the use of a model demonstration-observation classroom and the establishment of an extension course through a university or college.

Fouracre (1966) addressed himself to deficiencies and suggested improvements in the practicum for student teachers of the MR. He found these deficiencies in present teaching programs: (a) the students are assigned to a classroom where the program is planned by the cooperating teacher, (b) the students have limited classroom responsibility, (c) the students are permitted to read case records before entering the classroom, (d) the coordinator has little control over the student teacher, and (e) the college supervisor's visits are brief and conducted without knowledge of the student's lesson plan. According to Fouracre, a desirable practicum should include: (a) close cooperation between the college and the participating school, (b) a competent cooperating teacher, (c) adequate college supervision of the practicum, (d) a college supervisor selected on the basis of a successful background of classroom management, use of teaching methods and materials, and curriculum development. The supervisor should be appointed and paid jointly by the college and the participating school.

Teachers of the trainable mentally retarded (TMR). A number of sources have listed the components of a TMR teacher a preparation program (Cain & Levine, 1963; Connor & Goldberg, 1960; Council for Exceptional Children, 1966; Heber, 1963; Wolinsky, 1959). Wolinsky (1959) analyzed aspects of a teacher education program for those preparing to work with the trainable child. She recommended three areas of study to be incorporated into any such program: (a) an adequate foundation in developmental psychology, including emphasis on laboratory experiences and the case-study approach; (b) acquaintance with basic skills and insights of other disciplines concerned with atypical children; (c) awareness of basic principles of counseling and interviewing. Of particular interest is the preliminary report to the Professional Standards Committee of the Council for Exceptional Children, in which preparation of teachers of the TMR was considered separately from that of teachers of the educable mentally retarded (EMR). Areas requiring intensive attention for teachers of the TMR were these: (a) cognitive growth, perception, and sensorimotor development, (b) research and evaluative skills. (c) language development, (d) concepts of leisure time, (e) occupational education, (f) counselling of parents, and (g) the role of the teacher as an eliciting stimulus.

Lance (1968) reported a pilot program under development at California State College at Fullerton to prepare teachers of the TMR. The program includes a one-semester seminar and practicum course to precede student teaching. During this seminar and practicum, the student spends three hours a week in seminar and nine hours in practicum, all under the supervision of a college faculty member. The seminar and practicum replaces a separate course in curriculum and methods and attempts to cover the same material in a more integrated and meaningful fashion.

Teacher competency. Conant (1963), Keppel (1961) and Sarason, Davidson, and Blatt (1962) agree that to improve teaching competency, professional education should intervene once the student has gained a firm footing in general education and in content areas. However, they disagree on when professional education should be initiated and how general competency is best attained. For some (Keppel, 1961; Sarason, et al, 1962), professional education should come in the last year of a five-year program; according to Conant (1963), however, teachers can be prepared in four years. The five-year work-study plan proposed by Trump (1958) and use of undergraduate seminars (Sarason, et al., 1962) reflects the current emphasis on practical experience for potential teachers.

Many organizational plans have been developed that have implications for the preparation of teachers (Hillson, 1965). Team teaching appears to be receiving considerable attention in institutions of higher education (Shaplin & Olds, 1964) as is the clinical approach (Schwartz, 1967a, 1967b; Smith, 1968). Schwartz (1967a) described an integrated teacher education program designed to prepare teachers for the education of exceptional children. He favors integrating the five traditionally separate training areas in Special Education into one curriculum, on the principle that every teacher must be a diagnostician who teaches each child at his own level, makes use of the child's capabilities, and ignores the formal etiological classifications.

Characteristics of special education teachers. Although many studies have reported the characteristics of regular class teachers, there is a lack of empirical information about the characteristics of effective special education teachers and about the predictors of effective teaching of the mentally or physically handicapped. The frequently quoted study reported by Mackie, Williams, and Dunn (1957) is no exception to this generalization.

To identify and quantify the traits which contribute to successful student teaching of mentally and physically handicapped children, Meisgeier (1965) investigated five dimensions of human behavior. Three characteristic patterns emerged: The successful student teachers (a) were well-adjusted, emotionally stable, and able to cope with difficult special class situations, (b) they possessed physical energy, vitality, and enthusiasm necessary to meet special classroom demands, and (c) they obtained high scores on measures of scholastic achievement and ability.

Willman (1966) investigated the significant differences between special education and elementary teachers on the Edwards Personal Preference Schedule, the Minnesota Teacher Attitude Inventory, the Study of Values, and a biographical data sheet. Differences in basic needs, attitudes, and interests were anticipated in the light of Murray's (1938) contention that differences in desired goals are the result of differences in basic needs. The results revealed relatively large differences in the basic needs, attitudes, and interests of prospective special education and of elementary teachers. However, relatively small differences were found among education majors in the various areas (e.g., mental retardation, emotional disturbance) of special education.

Several studies (Cawley, 1964; Garrison & Scott, 1961; Jones & Gottfried, 1964, 1966; Philippus, 1961; Roberts, 1962) have described the personality characteristics of teachers or prospective teachers of exceptional children. Gottfried and Jones (1964) explored some of the underlying factors in the choice of a career in special education. Using a questionnaire technique, they collected information about (a) previous contact with handicapped persons, (b) date of career choice, and (c) reasons for entering the field. Analysis of the data showed that approximately 40% of the respondents had had some

prior experience with handicapped individuals. Most of the respondents reported deciding on a special education career in the senior year of high school or freshman year of college. The most frequently stated reasons for entering the field were previous contact with handicapped children, a desire to help others, and the challenge of the work.

In a later study, Jones and Gottfried (1966) investigated the personality and motivational characteristics not only of teachers employed or expressing interest in teaching various types of exceptional children but also of prospective elementary and special education teachers. Besides completing one of two standardized tests (The Edwards Personal Preference Schedule or the Teachers Preference Schedule), each subject ranked his preference for teaching 12 different types of exceptional children. The results suggested that preferences for teaching various types of exceptional children are related to specific psychological needs and gratifications.

Philippus (1961) investigated the values and interest patterns of student teachers in elementary, secondary, and special education at the University of Denver. Significant differences were found between the special education and elementary education students. The special education group scored highest on the biological science, persuasive, linguistic, and humanitarian scales of the Thurstone Interest Inventory; on the debonair sexual and general uninhibitedness scale of the IPTA Humor Test and on the religious scale of the Study of Values.

Roberts (1962) compared the needs, interests, and values of elementary, secondary, and special education teachers on the Edwards Personal Preference Schedule, Thurstone Interest Inventory, and the Study of Values. Special education teachers scored relativity high on nurturance needs and computational interests, and relativity low on linguistic interests and political values.

Although Philippus (1961) and Roberts (1962) used some different instruments, their findings point to differences between the prospective and experienced special education teachers; certain personality characteristics may be acquired after an individual begins teaching.

An important limitation of most teacher characteristics studies, not found in those reported by Philippus (1961), Roberts (1962), and Willman (1966), is that investigators generally failed to test teachers of nonexceptional children or persons employed in other occupations. Thus, while a given constellation of traits may be seen as characteristic of teachers of a given type of exceptional child, the traits may in reality differ little from those of persons in a wide variety of seemingly diverse occupations.

According to Lord and Wallace (1949), the influence of friends and relatives, as well as actual contact with exceptional children, helped shape the decision to become a special education teacher. These findings were confirmed by Gottfried and Jones (1964) and by Meyers (1964). In all three studies there was some evidence that preteaching experience is related to the decision to teach exceptional children.

Several studies (Badt, 1957; Jones & Gottfried, 1962; Meyers, 1964) of preferences for teaching exceptional children reveal that certain teaching specialities have greater attractiveness than do others--in particular, work with the emotionally disturbed, the gifted, and the retarded.

In her study of the status of teachers of the mentally retarded, Rich (1960) focused on the personal background of teachers. She found that 62% of her sample preferred to teach the mentally retarded because the work seemed more challenging, but 12.2% of the teachers would have preferred to teach in the elementary grades. Reasons given by teachers for discontinuing their work with the mentally retarded included: (a) a desire to return to regular

classroom, (b) difficulty of the work, (c) discouragement with the results obtained, and (d) lack of emotional stability.

Heller (1964) studied the relationship between certain background characteristics of special education teachers and their decision to leave special education. He found a significant relationship between the decision to leave the field and a lack of previous experience with exceptional children. Teachers leaving the field ranked the factors influencing their decision in the following order: (a) lack of adequate supervision and administrative support, (b) undesirable working conditions, (c) lack of adequate college preparation for teaching, (d) lack of acceptance by fellow colleagues in education, (e) inability to manage classroom, (f) lack of acceptance of special education by the community, (g) family and personal reasons, (h) economic reasons, and (i) lack of stimulation.

Attitudes of college students toward handicapped groups have also been studied (Badt, 1957; Barker, 1953; Means, 1936; Mussen & Barker, 1944; Rusalem, 1950; Rusk & Taylor, 1946). However, research on the attitudes of special education majors and experienced teachers as compared to those of elementary education majors and experienced teachers is relatively exiguous. Semmel (1959) investigated teacher attitudes toward mental deficiency in relation to the amount of information about the condition. As expected, the special education teachers showed significantly greater knowledge of mental deficiency than did elementary teachers. There were, however, no significant differences in attitudes between the two groups.

Some data are presently available to aid the selection of candidates as teachers of exceptional children. The Minnesota Teacher Attitude Inventory has been used in a screening process (Condell & Tonn, 1965; Meisgeier, 1965). Johnson (1964) developed a questionnaire that may help determine some of the

important variables of past experience with the handicapped as related to current interest and possible success. Lance (1968) recommends Hudson's (1960) checklist of teaching competencies of teachers of TMR children as a screening or evaluation device.

The foregoing review suggests that critics of special-education teacher education programs are correct in their assertion that little relevant research has been conducted in this field. Systematic research on training teachers of the mentally retarded is almost non-existent. In the following section of this paper, research using analytical systems of classroom interaction reviewed. These systems and the research they motivate have direct relevance to the general question of teacher training in special education.

B. Analytical Systems of Classroom Interaction

This section of the review is organized in accordance with the focus of various proposed systems for analyzing classroom behavior. The two focal areas in question are: (a) cognitive processes, and (b) social-emotional climate.

Cognitive processes. Smith and Meux (1962), in one of the first studies in this area, sought to determine what logical patterns, if any, were to be found in teaching. They analyzed tapescripts from 85 class sessions of 17 high school teachers of four different subject matters in terms of two basic units (episode and monologue). An episode was defined as one or more exchanges which in the aggregate comprise a completed verbal transaction between two or more speakers. The monologue consisted of the sole performance of a speaker addressing the group. Episodes were found to contain opening, continuing, and closing phases. They constructed 13 categories to analyze the opening phase

of episodes. Differences in logical operations are found from teacher to teacher and from subject matter to subject matter.

A multi-dimensional approach was developed by Medley and Mitzel (1963). The authors criticized their own observational scale (OScAR) because it failed to examine the cognitive aspect of classroom interaction, which they believed to be more important than the social-emotional aspect.

Using Piaget's theoretical model, Taba, Levine, and Elzey (1964) constructed a classification system employing pedagogical function and level of thought as its categories. The authors trained 20 elementary school teachers to use a social skills curriculum and teaching strategies designed to develop cognitive skills. They tape-recorded each class four times during the school year. Their findings indicated that such pupil characteristics as IQ, social status, achievement in social studies, and reading comprehension were not correlated with the level of thought expressed in the classroom discussion. Results confirmed the hypothesis that with "good" teaching and a "good curriculum" slow learners were capable of abstract thinking. The manner in which the teacher asked questions turned out to be the most influential teaching act; it circumscribed the mental operations of the students.

Bellack, Hyman, Smith, and Kliebard (1965) studied the teaching process through analysis of the linguistic behavior of teachers and students in the classroom. Wittgenstein's model of language games was used in analyzing the cyclical patterns of pedagogical moves. The classification system devised consisted of three dimensions: pedagogical moves (structuring, soliciting, reacting, and responding), content moves, and emotional moves. Lieman (1966) is using Bellack's system to study the one-to-one relationship of teachers and pupils involved in homebound instruction.

The dimension of intellectual operations derived from Guilford's analysis of the "structure of intellect" became the basis for GACS, the Gallagher-Aschner Classification System (Gallagher, 1965). The five major categories of this system differed from those of Guilford's model in that cognition and memory were combined into one category and a category for routine classroom procedure was added. Each statement in the classroom was assigned to one of the following categories: (a) Routine, (b) Cognitive-Memory, (c) Convergent Thinking, (d) Evaluative Thinking, and (e) Divergent Thinking.

In addition to tape recording the proceedings, two observers in the classroom during each recorded session took extensive notes on the classroom activities. They noted, for example, such features as blackboard diagrams and written materials. In addition, they tried to identify the more obvious attitudinal dimensions of interaction between teacher and class, such as censure, praise, frustration, and humor. Each transcribed classroom session was then classified, unit by unit, by trained judges working with the scoring manual developed for this purpose. These codings were transferred to a flow chart for more extensive analysis.

Gallagher (1965) used the GACS to study the verbal interaction of five superior social studies, science, and English teachers and their intellectually gifted high school students. He concluded that the teacher had the crucial role of initiator and determiner of the thought processes expressed in the classroom. He is in a position to facilitate or inhibit the development of effective productive thinking in his students. If the teacher's behavior is so important for the intellectual development of gifted children who are capable of much independent learning, then it must be still more important for the development of mentally retarded children who purportedly are less capable of independent learning.

Aschner (1963) used the GACS to investigate the relationship between the variables of IQ and class size on the one hand and, on the other, student initiative, which was operationally defined in terms of specific secondary categories. Gifted high school students exhibited significantly more initiative than average and mentally retarded students; however, the mentally retarded subjects produced more initiative units than the average students. Aschner attributed this finding to the informal, comfortable atmosphere created by the special-class teacher.

Using the GACS, Cawley and Chase (1966) compared the verbal interactions of retarded children in special classes, retarded children in regular classes and non-retarded children in regular classes. The results for all three types of classes were similar. Of the total units produced, one-half were classified as cognitive-memory, 80% as cognitive-memory and routine combined, and less than 5% as evaluative and divergent thinking.

Minskoff (1967) used the GACS to examine the verbal interaction in MR classrooms characterized by Goldstein's inductive method of teaching. She found that teachers used more cognitive-memory questions than other question types. Approximately equal amounts of convergent-thinking, divergent-thinking and evaluative questions were used by the teachers. Minskoff's prediction of a high positive correlation between the thought process implied by a question and the type of response produced by a student was supported. Moreover, the predicted differences between the inductive teachers and a control group, when measured on verbal interaction, were confirmed.

David and Tinsley (1967) developed the Teacher Pupil Question Inventory (TPQI) which uses the questions asked by student teachers and their pupils to determine the range of cognitive objectives manifest in secondary social studies classrooms. The TPQI schedule requires a classroom observation of 30 min.,

divided into alternating 5-min. periods. At each instance of a question asked by either the teacher or pupil, the observer decides the category of the question and marks a tally in a space provided. Questions are judged by their form and inferred intent as well as by the nature of the response elicited and its reception by the pupil or teacher. The TPQI has nine categories, seven of them based on the Bloom taxonomy and the formulations of Sanders (1966). The other two categories concern non-cognitive questions. The results revealed that both teachers and pupils asked more "memory" questions than all other questions combined. The next largest number of questions fell in the "interpretation" and "translation" categories. "Procedure" questions for both teachers and pupils and "evaluation" questions for teachers came next in the descending order of frequency.

Hudson (1960) investigated public day-school classes for trainable mentally retarded children in Tennessee in an attempt to provide more specific information about the "how" of teaching, as illustrated by the teaching techniques used, and the "what" of teaching, as seen in the types of lessons taught. She identified:

(1) Forty-three teaching techniques and

(2) Seven "a-priori" clusters:

(a) controlling individuals and groups,

(b) Getting the children willing to start and continue working,

(c) Building a sense of personal worth in the children,

(d) Structuring or guiding learning,

(e) Encouraging cooperative interaction,

(f) Providing for mind-set or attention,

(g) Drawing from children--as opposed to pouring in--Verbal.

Hurley (1967), while developing a system for analyzing teacher-pupil verbal interaction, reported several findings:

(1) In terms of the number of words uttered, teachers did about 85% of the talking.

(2) EMH children averaged less than one complete sentence per utterance while the teacher produced more than two.

(3) About 80% of the teacher's sentences were structurally complete, whereas only about 20% of the children's sentences were.

(4) The children were seldom given the opportunity to use structurally complete sentences (nor were they asked to). During recorded sessions totalling 4 hrs. 24 mins., only 41 complete sentences were uttered by the children.

(5) According to the normative tables provided by Johnson, Darley, and Spriesterbach (1963), the level of the children's language was roughly that of a five- or six-year-old.

(6) The children's complete sentences were compared to an equal number of randomly selected teacher sentences by means of an initial version of the modified Shriner Length and Complexity Index (LCI) (Shriner, in press); teachers' sentences showed a wider range of complexity than the children's.

Social-emotional climate. The dimension of classroom interaction most frequently studied has been the social-emotional climate (Medley & Mitzel, 1963). The forerunners of such studies were those by social psychologists such as Bales (1951) who observed small group social interactions. Anderson's

(1939) studies on dominative and integrative teaching patterns pioneered social-emotional research in the classroom. Withall (1956) derived a climate index to reflect the degree to which a teacher was learner-supportive (integrative) or teacher-supportive (dominative).

Flanders (1961, 1963, 1964, 1965) has reported the most comprehensive program of investigation based on classroom observation. His Interaction Analysis (IA) technique is composed of ten categories: Teacher (a) accepts feeling, (b) praises or encourages, (c) accepts or uses ideas of students, (d) asks questions, (e) lectures, (f) gives directions, (g) criticizes or justifies authority; Pupil (h) responds, (i) initiates, and classroom behavior consists of (j) silence or confusion. In using IA, an observer decides, during 3-sec. intervals, which category most appropriately describes the interaction taking place in the classroom. The observer records the category numbers in the sequence in which they occur, and so preserves the original order of verbal events. For example, the sequence of tallies "4-8" means that the teacher asked a question and a student responded.

The observer also notes the types of activity (e.g., discussion, filling out materials, etc.), the class formation, and the subject matter. Each time there is a shift in activity, formation, or subject matter, the observer notes the changes and continues tallying.

At the end of an observation period the frequency of tallies in each category can be counted, and the percent occurrences of each behavior category determined. For example, during a science discussion a teacher might praise 1% of the time, lecture 30% of the time, and ask questions 12% of the time.

Since the order of verbal behavior is preserved in the tallying, it is also possible to determine how often one category follows another. For example, a teacher might praise student's initiation 5% of the time that it occurs, and

differences affect the learning of children. In his study he used the University Revision of the Provo Code for the Analysis of Teaching. It contains 33 functions that teachers perform in the classroom in interaction with children. Seven major categories are identified: (a) controlling functions, (b) imposition of teacher, (c) facilitating functions, (d) functions that develop content, (e)functions that serve as response, (f) functions of positive affectivity, (g) functions of negative affectivity.

Perkins (1964) constructed two instruments, Student Categories and Teacher Categories, derived from instruments for measuring student-behavior, learning-activity, teacher-behavior, and teacher.role variables presumed to be related to differences in achievement. He concluded that using these instruments to determine the ways teachers resemble and differ in behavior, function, role, and teaching process promises further breakthroughs in studying teacher influence and effectiveness and in developing a theory of instruction.

MacDonald and Zaret (1968) focused on the interactive verbal behavior of teachers and learners in a specific instructional context (a social studies discussion or planning session) in order to ascertain whether the proposed process continums stretching from open to defensive and compensatory behaviors could be reliably identified, categorized, and analyzed. The goal of their work was to use the tested framework to generate hypotheses for future broad and intensive studies on ways to increase effectiveness in teaching. MacDonald and Zaret contend that the classification system of the process continuum (opening-closing) is a promising tool for interaction research in classrooms.

Pierce (1967) recorded 96 teachers of culturally divergent children on vidicon (90-min. segment) and classified the reinforcement behaviors used into the following categories: (a) Positive Verbal, (b) Negative Verbal (c) Positive

Physical, (d) Negative Physical, (e) Positive Covert, (f) Negative Covert, (g) Supplemental Enrichment. Negative types of reinforcement turned out to be more easily identified than positive types.

Gallaway (1968) set up seven categories for observing a teacher's nonverbal communication with pupils in instructional settings. The purpose was to enable observers to make inferences about the nonverbal behavior of a teacher. When a communicative act pertinent to the category system occurred, observers recorded a number standing for the category. Three of the categories (enthusiastic support, helping, receptivity)were considered as encouraging communication, three as inhibiting it (inattentiveness, unresponsiveness, disapproval). The neutral category, pro forma, was considered as neither encouraging nor inhibiting.

Of particular interest is the contention that nonverbal messages may be as significant to pupils as are direct teacher verbalizations--particularly when pupils attempt to ascertain the teacher's true feelings and attitudes toward them. The notion is all the more relevant in the case of linguistically disadvantaged youngsters, who get lost in the verbal avalanches of teacher talk in classroom settings and have no other recourse than to rely upon the nonverbal messages of teacher behavior. The research conducted by Bernstein (1961) has shown that youngsters from the lower classes depend upon nonverbal cues for the detection of meaning in school situations.

A summary of the literature of systems for analyzing classroom behavior has shown that a variety of systems has been developed. Some systems focus on the teacher while others focus on both the teacher and the pupils. Most of the systems analyze verbal behavior in the classroom as the prime means of communication, considering it to be a representative sample of the total classroom behavior. Others include or focus on the nonverbal behavior,

considering it too significant to omit in spite of the many limitations inherent in dealing with it.

In the area of special education the Gallagher-Aschner Classification System has been used with gifted and mentally retarded high school pupils, and EMR elementary students. Flanders' Interaction Analysis has been used with both TMR and EMR groups; and Bellack's system has been used with the homebound. No research on nonverbal communication within special education programs has been located.

The previous sections of this review have implied the need for information feedback to teachers in training. The final section of this review summarizes the work reported on the role of feedback variables in teacher education.

C. Feedback Variables in Teacher Education

The use of some type of feedback to teachers in training is not new, at least in theory--the traditional role of the supervisior has been to provide meaningful feedback in training programs (Anderson & Junka, 1963).

It is clear from the above review of analytical systems that efforts have been made to standardize the recording of student-teacher behavior for use as feedback to the teacher. There have also been several recent attempts to alter the nature and time of that feedback.

DeViney (1963) used a closed circuit television link for observation of elementary teacher trainees. The effectiveness of TV monitoring was assessed primarily by attitude questionnaires given to the students. No significant findings were reported--the researcher suggested that the dependent measure used was inappropriate.

Oliver (1965) used video recordings for observation. Self analysis of the tapes turned out not to be so effective as help in analysis from a

supervisor. More change occurred in student-teacher behavior when visual rather than just verbal feedback was available; and more change occurred when feedback came from an analysis of the video tape by the supervisor rather than from the impressions of an on-the-spot supervisor.

Meir (1967) used systematic visual feedback to teachers from the students, who indicated their reactions by holding up cards at various intervals. This type of feedback influenced teacher behavior and resulted in more appropriate decisions to reteach material. The students in the class did better on post-test performance than did a control group.

Allen and Ryan (1965) described micro-teaching as a new method of supervision. They introduced video-tape recording and short segments of teaching (micro-teaching) as tools and techniques for change. Teaching skills were isolated and described. A novice teacher was shown an example and asked to try himself; his attempt was taped, critiqued, and could be taped and critiqued again. Allen does not claim to have an exhaustive list of teaching techniques but says that his method points the way toward a more objective examination of skills.

Meier (1968) reports the use of micro-teaching as a training technique for teachers of disadvantaged preschool and kindergarten youngsters. Borg (1968) used a similar technique for inservice training of teachers. However, the classification system provided for no other type of student verbal behavior than responding.

Minnis (1963) examined video-taping sequences in terms of Flander's interaction analyses and in the context of a comprehensive training program. Student teachers spent the first phase of their teacher-training career learning interaction analysis. They then observed demonstration teachers. Several teaching patterns were isolated for learning and a technique such

as Allen's was used in conjunction with interaction analysis during the critique period. Minnis views this type of training program as a poweful tool for continuing self-education after the teacher leaves the training situation.

The use of tape recordings as a substitute for the initial observation period of most teacher-training programs was explored by Mijer (1964). Analysis and discussion of edited tapes effectively replaced lectures.

In an attempt to teach methods of observation and classroom analysis, to secondary education trainees, (Springman (1966) presented audio-video tapes of classroom situations and asked both student-teachers and experienced teachers to rate them on various observational criteria. Novice and experienced teachers differed in rating inner-city as opposed to suburban classrooms. The student-teachers trained in rating with the help of tape came to resemble the experienced teachers in their judgments more rapidly than did a control group.

Time-lapse photography was introduced by McGraw (1966) as a feedback device and a method for observing student teachers. He was primarily interested in non-verbal behaviors which he labeled "attending behavior." Various cues were isolated and their recognition taught to the student teachers through examination of the filmed record of their classes, all this in an effort to sensitize the teacher rapidly to the cues. According to McGraw the attending behaviors of individual students correlated well with their class achievement.

Johnson (1967), using video-tape programming to train student teachers to assess classroom behavior, found that trained observers did well on subsequent analysis of their own recorded classrooms but that untrained observers did not.

The Computer as a Feedback Source

As yet, the computer has been only minimally employed as a feedback device for teachers. Systems Development Corporation has constructed an automated classroom called CLASS which allows students to interact with an individual course of programmed instruction and also privately with the teacher. In this system the teacher is the "trouble-shooter" and intervenes when the programming proves to be inadequate for the student.

Baker (1963) assigns the computer several roles in educational research: (a) simulation in such areas as learning and problem solving. behavior in social groups, personality, and administration, (b) pattern recognition of data, (c) automated classrooms like CLASS, (d) information storage and retrieval, and (e) theory development.

For Taylor (1967), several aspects of human interaction with the computer constitute problems for research: (a) the internal representation of a problem within the machine, (b) the nature of the surface structure by which man and computer interact, and (c) the use of this interaction to solve problems. He finds that little work has been done on the third area.

The computer has been used for data analysis and computer simulation of cognitive processes (Feldman, 1962), business simulation (Sprowls, 1963), simulation of international relations and diplomacy (Benson, 1962), organization theory (Rome & Rome, 1962) and nerve-net simulation (Culbertson, 1962).

Mayzner, Tressalt, and Helfer (1967) suggested lines of research on the optimal characteristics of visual display for man-machine interaction: (a) types of display, (b) the order, (c) the rate of presenting information, (d) the size of the display and its inputs to the observer, (e) the intensity of illumination, (f) the spacing, (g) number, and (h) content of inputs.

In some studies computers appear as experimenters. The machine selects the stimuli, presents them to the subjects, and records and analyzes the responses. Cooperband (1966) described such an experiment in perception and discussed the advantages and disadvantages of his computerized system. Videback and Bates (1966) studied verbal conditioning, in this way, with the computer programming reinforcement of correct responses.

McCandless and Best (1964) conducted an experiment in age differentiation in response to auditory stimuli. The computer provided immediate output describing response patterns of various age groups when the stimuli were varied around four parameters. Johnson (1967) used the computer as the experimenter in problem-solving experiments.

Education has begun to expand the use of computer-assisted instruction (CAI). A review and discussion of this area is presented by Hansen (1966). The classroom computer has been most popular in mathematics and business education, areas that are primarily concerned with the computational aspects of the computer (Riedesel & Suydam, 1967).

The use of the computer for test administration and for bookkeeping tasks such as recording attendance and grades and scheduling classes seems to be the first time-saving contributions that educators have investigated. CAI systems in many subject areas for different educational levels are currently receiving attention. Though a program to simulate small-group behavior is available, the computer has not, to the reviewers' knowledge, been used to enhance training. That such a use of the computer is feasible is suggested by the program described by Bellman, Friend, and Kurland (1966), who attempted to train students to conduct initial psychiatric interviews. The capabilities of computers for rapid analysis and summarization of data imply their possible usefulness as feedback devices for teacher behaviors.

Such utilization has promise for supplying teachers in training with instantaneous feedback of relevant variables while eliminating the tedium of coding, analyzing, and summarizing data collected through existing analytical systems.

D. Summary and Conclusions

This preliminary review of the literature has revealed relatively few attempts at systematically improving teacher education programs in special education. The reviewers were unable to discover accounts of special education training programs with clearly defined objectives and methods designed to modify teacher behavior. Although many systems of classroom analysis have been developed by general educators, their use in teacher education is currently limited by a characteristic delay of feedback to the trainee and by the tedium of coding, summarizing, and analyzing the data collected. No system among those reviewed drew upon an analysis of special educational techniques so as to incorporate the specific characteristics of the pupils into the system. Computers are beginning to be used more frequently in education and training but we have found no reports of the use of computers in a cybernetic system for the analysis and feedback of teacher-pupil behaviors in the classroom. The present review suggests the need for the development of a Computer Assisted Teacher Training System (CATTS). It is toward this objective that the senior reviewer and his associates at the Center for Research on Language and Language Behavior (University of Michigan) are currently working.